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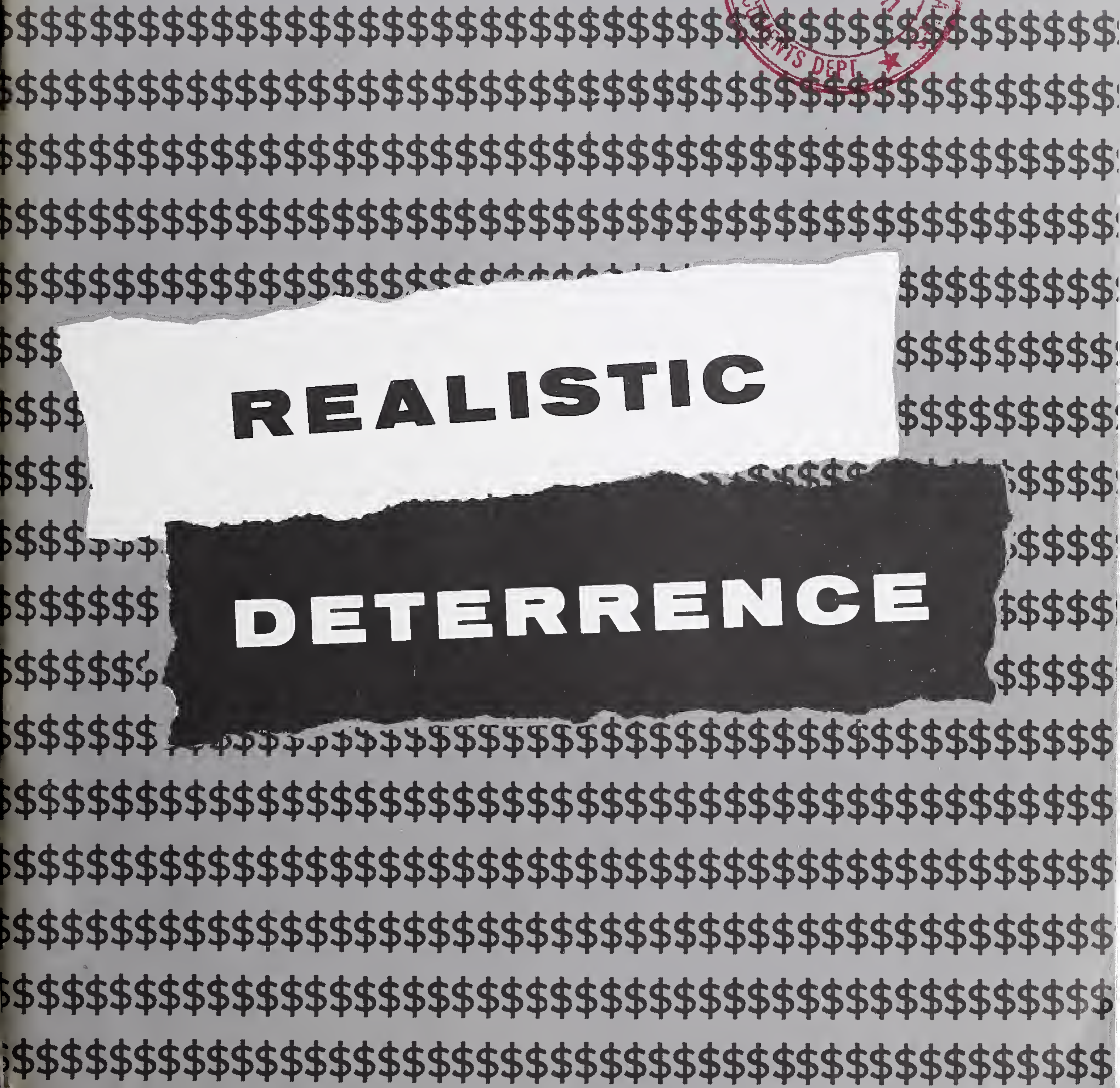

REALISTIC DETERRENCE

DEFENSE INDUSTRY BULLETIN

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The *Bulletin* serves as a means of communication from the Department of Defense and its components to actual or potential defense contractors, labor and other interests. It provides information and guidance on official policies, programs, procedures, activities and developments concerning the management of research, development and acquisition of equipment, supplies and services needed in the national defense effort. It seeks to stimulate thought by the defense-industry team in solving problems allied to the defense effort.

The *Bulletin* is distributed free of charge to qualified representatives of DOD components, industry, labor and other persons engaged in the defense-industry relationship. Subscription requests should be submitted on organization letterhead, and must indicate the organization's and requestor's participation in the defense-industry relationship. Send requests to: Editor, Defense Industry Bulletin, Defense Supply Agency, Cameron Station, Alexandria, VA 22314.

Suggestions concerning possible subjects for future issues are welcome and should be sent to the Editor.

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FY 1972 Defense RDT&E Program

Research and Development in U.S. Defense Posture

Dr. John S. Foster Jr.

The policy of realistic deterrence seeks to further the goal of peace by successful deterrence of armed conflict at all levels. In formulating the strategy to implement this goal, Secretary of Defense Melvin R. Laird realistically considered the multiple threats to peace, the need for strength, and the strategic, manpower, political and fiscal realities of our times. An additional goal was to attain a defense force that in peacetime would require no more than 7 percent of the gross national product.

Two of the keystones of the strategy of realistic deterrence are *strength* and *partnership*. In speaking of our *strength*, Secretary Laird has emphasized that:

- Our strategic offensive and defensive power must continue to be sufficiently versatile to deter any nuclear attack on the United States or our allies, and to serve as the cornerstone of the Free World's deterrent of nuclear attack.
- Within the limits defined by the President's foreign policy statement, our conventional forces, combined with those of our allies and friends, must be capable of deterring aggression by their *versatility* and *flexibility* to respond rapidly to potential conflicts.
- In structuring our conventional forces to maintain their effectiveness with lower force levels in terms of men, guns, ships and aircraft, we must ensure, through a more vigorous research and development program, that U.S. equipment continues to be modern and increasingly more effective and reliable. Thus, while the overall defense budget, which is primarily dictated by force levels, is slated to increase by only 2 percent in FY 1972, an increase of 12 percent is being requested for the research and development portion, the primary determinant of future force quality.

Secretary Laird has also stressed that we seek *partnership*. The goal is twofold: We must provide equipment and training to our allies to reduce dependence upon U.S. forces, while at the same time we must take advantage of the technological resources of our allies for our common purposes.

The policy keystones of strength and partnership dictate research and development programs which will:

- Ensure the continued survivability, penetration capability, and flexibility of our strategic deterrent.
- Ensure our capability of control of the seas as necessary to protect our tactical forces abroad.
- Preserve the maximum effectiveness of our tactical forces at *lower* force levels, and not only provide our men with more effective and reliable weapons but also maintain a strong technological base for the development of improved systems in the future. We must design weapons with more emphasis on cutting the cost of ownership through improved reliability and maintainability.
- Give special emphasis to test and evaluation, particularly the operational aspects.
- Provide for new initiatives which will significantly improve our capabilities.
- Provide management methods which will promote optimum utilization of our research and development resources in the face of the realities of a tight defense budget and a considerable Soviet commitment to technological superiority.
- Encourage interdependence in weapons research and development

Dr. John S. Foster, Jr.
Director, Defense Research and Engineering

with those allies possessing well developed capabilities.

- Devise ways to couple our technological capabilities with the manpower resources of our less powerful allies.
- Identify areas of current or projected future deficiency in our weapon systems or forces to which technological resources can be applied.

Divergent Trends

Of increasing importance in all our planning is the formidable Soviet effort to achieve *military* technological superiority. For several years U.S. analysts have watched the growing Soviet commitment to militarily related research and development with increasing concern. While U.S. research and development spending in this area has leveled out and then declined in recent years, the Soviets have continued to increase their expenditures at a rate of about 10-13 percent per year according to calculations. The Soviet thrust in this area continues and their effort in military research and development is now significantly larger than that of the United States. The best estimates are that this differential is now equivalent to some $3 billion a year in terms of 1968 dollars.

In order to mount a technological challenge to the United States, it has been necessary for the Soviets to increase the number of technically qualified people available to improve the quality and quantity of laboratory and engineering facilities, in addition to the increases in the amount of money devoted to their military research and development efforts. Independent studies indicate that these steps have been and are continuing to be taken.

Since analyses of resource *inputs* to research and development cannot address the question of whether these resources are used effectively, last year DOD initiated a study to compare the relative military and space technological *outputs* of the United States and the Soviet Union.

In this study, we compared the date on which each nation had the option to produce a given, comparable weapon system, *e.g.*, in 1968 the Polaris boat was considered to have a five-year technological lead over the comparable Y-class submarine. By making many such comparisons for the period 1960–1968, it was possible to follow technological changes and, thus, determine how many years it took the Soviet Union to reach given levels of U.S. technology.

The findings of this net technical assessment were:

- Both countries had about the same number of major systems under advanced (visible) development during the period 1960–1968.
- While the technological lead time in years changed for individual major weapon systems and even for major weapon system categories, on the average the United States retained its two- to three-year technological lead in military systems.
- In space technology, the United States advanced its technological lead by several years.

There is a clear correlation between this net technical assessment and the resource comparisons for the same time period (1960–1968), which show that:

- Both countries had about the same military Research, Development, Test and Development (RDT&E) budgets.
- The United States had the greater space RDT&E budget.

An important conclusion to be drawn from this study is that *the payoff in weapon quality seems commensurate with the level of effort in both countries.*

Today, while our research and development level of *effort* is now smaller, we believe that the United States is still *technologically* ahead of the Soviet Union—ahead on quality of weapons—by perhaps two or three years on the average. *If* present trends continue, however, the larger and increasing Soviet effort could result in the following:

- The Soviet Union could assume technological superiority in military research and development in the latter half of this decade. This superiority might be observable by the mid-1970s through the appearance of unexpected prototype military systems which, if produced, could make major U.S. weapon systems obsolete in the late 1970s. Their new missile silos may be an early first example of results of the incremental Soviet effort.
- Loss of U.S. technological superiority would markedly reduce our understanding of the intelligence we do collect and, as a result, seriously impair our confidence in our ability to make decisions about future weapon systems.
- Present relative trends in quality, coupled with the comparable trends in quantity—indicated by relative numbers of improved weapons deployed—could seriously jeopardize the U.S. margin of security in the 1975–1985 time period.

Recovery from such a loss of U.S. technological leadership would require enormous expenditures over many years—years of grave risk to our national margin of safety.

These facts are cause for serious concern—far too serious to be neglected. We recognize that other needs of our nation are so great that it is neither feasible nor practical to consider matching the apparent Soviet effort at this time. We therefore consider that the disparity in U.S./USSR technological efforts is a warning to alert us to potential dangers in future years, and it is a demand to ensure that our military research, development, test and evaluation effort is properly funded and managed to minimize these dangers.

FY 1972 RDT&E Budget Request

For FY 1972, we are requesting $7.88 billion in total obligational authority for the DOD RDT&E program. This represents, in equivalent 1972 dollars, an increase of $500 million in purchasing power over that appropriated for FY 1971. The increased total is based on:

- Prior decisions regarding ongoing major programs.
- Striving to maintain force effectiveness by improved equipment and techniques as force levels are decreased.
- Maintaining a technological margin of security against an increasing Soviet technological challenge.

Last fall, faced with the unfavorable trends then discernible, DOD undertook a comprehensive top-level review of both the RDT&E program content and our management methods. A review of about 600 program elements resulted in renewed emphasis on some programs and reduction of emphasis or termination for others. This review will continue during the coming year because there is much yet to be done in this area.

Tactical Programs

The strategy of realistic deterrence calls for the deterrence of armed conflict at all levels. To attain this capability requires the augmentation of the research and development program on which we are embarked. To do that within the budget allocations reflecting our new national priorities will require considerable innovation in approach. The cost of new weapons precludes simply matching the Soviet Union ship for ship, tank for tank, and airplane for airplane.

Our approach with respect to conventional forces is to:

- Maintain a strong base of ongoing technology and to follow through with the major development programs already under way.
- Work with our allies to identify means of increasing the extent to which our research and development programs can be made to complement each other.
- Augment existing programs and initiate innovative new programs across all the key mission areas of tactical warfare in response to the Soviet threat.

Ocean Control. In recent years the Soviet navy has expanded rapidly from one with its attention focused sharply on undersea warfare to one in which surface fleets are also emphasized to attain ocean control. The Soviet navy clearly is modern, powerful and growing.

To provide the U.S. Navy with the capability for ocean control in the 1970s, emphasis is being given to programs in surveillance, communications, and offensive, defensive and undersurface systems. To enable our commanders at sea to locate enemy forces, the ocean surveillance program is being accelerated in FY 1972. We have also budgeted to improve undersea surveillance.

The LAMPS ship-based helicopter system will give our ships an over-the-horizon surveillance capability, and will provide targeting information for the ship-launched antiship missiles. In addition, the LAMPS system will extend the antisubmarine (ASW) effectiveness of our ships. For work on this system, $38.5 million has been included in the RDT&E budget. Also, the FY 1972 budget requests $30.9 million for the carrier-based E-2C airborne surveillance and air control system.

We seek early deployment of a system that would provide communications for fleet broadcast, ASW aircraft command and control, and some flagship data circuits as an element of our initiative effort. Funds have been requested for the development of sat-

Estimated Distribution of DOD RDT&E
(Total Obligational Authority—in $ Millions)

Distribution by:	FY 1970		FY 1971		FY 1972	
Mission						
Strategic	$2,489.7	33.4%	$2,110.5	29.7%	$2,334.6	29.6%
Tactical	2,574.5	34.6	2,543.5	35.8	3,091.7	39.2
Other Mission Research and Development	1,030.9	13.8	1,073.3	15.1	1,000.1	12.7
Technology Base	559.5	7.5	557.8	7.8	604.4	7.7
Support	796.3	10.7	774.1	10.9	807.3	10.2
Emergency Fund	—	—	50.0	.7	50.0	.6
TOTAL	$7,450.9	100.0%	$7,109.2	100.0%	$7,888.1	100.0%
Development						
Research	$ 324.4	4.4%	$ 321.4	4.5%	$ 321.9	4.1%
Exploratory Development	920.4	12.3	916.6	12.9	1,005.9	12.7
Advanced Development	960.7	12.9	1,037.9	14.6	1,456.7	18.5
Engineering Development	1,039.2	14.0	1,316.2	18.5	1,781.7	22.6
Management and Support	1,245.5	16.7	1,192.3	16.8	1,105.5	14.0
Emergency Fund	—	—	50.0	.7	50.0	.6
Operational Systems Development	2,960.7	39.7	2,274.8	32.0	2,166.4	27.5
TOTAL	$7,450.9	100.0%	$7,109.2	100.0%	$7,888.1	100.0%
Performer						
Industry	$5,007.0	67.2%	$4,587.5	64.5%	$5,353.7	67.9%
Government In-House	2,023.4	27.2	2,048.4	28.8	2,069.7	26.2
Federal Contract Research Centers	192.8	2.6	206.2	2.9	204.1	2.6
Universities	227.7	3.0	217.1	3.1	210.6	2.7
Emergency Fund	—	—	50.0	.7	50.0	.6
TOTAL	$7,450.0	100.0%	$7,109.2	100.0%	$7,888.1	100.0%

ellites and terminals for such a communication system.

A new set of satellites, intended to replace the interim Defense Satellite Communication System, will be completed in FY 1971. We intend to continue intensive development of new, reliable terminals, including antijamming equipment, in order to exploit the full potential of this new system.

We plan to initiate the development of a satellite communication system operating in the ultra-high-frequency band which will allow terminals to use much smaller antennas. This system should allow retirement of a great deal of current high-frequency radio equipment. Funds are budgeted in FY 1972 for the Navy and Air Force portions of this program.

In FY 1972, we plan to undertake system definition and design studies of a Defense Navigation Satellite System to support many ground, sea, airborne and space applications, including mapping and charting, navigation, guidance and position fixing, and air traffic control.

To counter Soviet submarines, the FY 1972 budget includes funds for ASW research and development. For the S–3A, $207.3 million will continue the program through the major milestones of first flight and completion of laboratory demonstration of the integrated avionics systems. Funds are budgeted for the continuation of engineering development of an improved submarine sonar, the BQS–13 DNA. Support is planned for the continuation of engineering development on a new mine called Captor.

For completion of competitive testing of the Mark 48 torpedo leading to selection of a single model to enter the Fleet, $21.1 million in research and development funds is programmed in FY 1972. Work on surface-to-surface offensive capabilities includes advanced development work of the new Harpoon missile intended for fleet introduction. The sum of $36.2 million is provided for in the budget for the design phase. Also included is $15 million to provide interim antiship missile capability and to initiate research and development leading to an antiship missile capability for U.S. submarines.

Research and development on advanced surface ships will include construction of prototype high-speed amphibious assault craft for competitive testing and extension of hydrofoil technology. For these projects, $13.7 million is provided. A total of $39.6 million is included in the FY 1972 budget for surface-effect ship (SES) projects consisting of testing of a 100-ton SES and, after initial testing, commencement of design effort on a follow-on ship. There is also $7 million included for studies on new surface ship concepts such as an air-capable ship and a new class of patrol frigates.

The sum of $100 million is budgeted for FY 1972 to continue engineering development on the Aegis integrated antiaircraft missile system. For development of high-speed maneuverable targets for test and evaluation support of fleet defense systems, such as Aegis and the F–14, $16.4 million is included in the FY 1972 program. These targets will also support air defense and air superiority weapon systems such as the Army's SAM–D and the Air Force's F–15.

Acquisition of highly sophisticated avionic and electronic systems has led to a need for new approaches to testing and maintenance. The better approach lies in the development of general purpose, computer controlled automatic test stations capable of testing a wide variety of different systems. In FY 1972, 15 VAST (Versatile Avionics Ship Test) stations will be produced to provide test and maintenance support to a major fraction of the avionics in the Navy's F–14, E–2C and S–3A aircraft. Intensive software development and verification programs will also continue.

Land Warfare. The most serious threats facing U.S. land forces are:

- Numerically superior armored force of the Warsaw Pact nations.
- Large tactical air force of the Warsaw Pact nations.
- Air defense capability of communist forces worldwide which inhibits air support of our ground forces. Particularly imposing are the surface-to-air missiles that have been demonstrated in the Middle East.
- The infiltrator, who becomes important in an environment of insurgency where there is no defined front line and national boundaries are remote frontiers.

The FY 1972 RDT&E budget request contains $103.8 million for efforts in the close combat area of land warfare. This includes continued emphasis on improving U.S. antitank and armor capability.

Funds in the amount of $9.1 million are being requested for service testing and development efforts directed toward adding more capability to both the TOW and Dragon missile systems. The budget contains $27.5 million to continue engineering development on the new, austere configuration of the MBT–70 tank, now designated XM–803. In FY 1972, we plan to begin development of two new combat vehicles—the Armored Reconnaissance Scout Vehicle and the Mechanized Infantry Combat Vehicle—for which $8.5 million is requested.

For the fire support area, the FY 1972 RDT&E budget contains $213.4 million. Funds are requested for advanced production engineering for the AH–56 Cheyenne helicopter in FY 1972. Air-to-surface missiles such as Maverick and Bulldog continue in engineering development and are expected to be ready for production soon. A sum of $47 million is requested to continue the AX development program in FY 1972.

To improve the capability against hard point targets of indirect fire support systems such as artillery, mortars, and surface-to-surface missiles, FY 1972 advanced development programs will initiate concept feasibility demonstrations and accelerated development of several new guidance techniques, including the application of homing to artillery projectiles.

With regard to field Army air defense, $131 million is requested to improve the effectiveness of the Chaparral and Vulcan systems. The FY 1972 program also requests approximately $1 million for evaluation of European-developed air defense systems such as the French Crotale, the United Kingdom Rapier, and the German Roland.

For medium- and high-altitude air defense, $5.3 million is requested to continue the Hawk improvement program. Engineering development is scheduled to begin in FY 1972 on SAM–D for which $115.5 million is requested.

The sum of $2.1 million is included

in the FY 1972 program for continuing the development of the TSQ–73 air defense control and coordination system.

A tri-Service program, Tri-Tac, has been initiated to meet the need for improved theater communication to control and coordinate U.S. tactical forces. To guarantee responsiveness to tri-Service needs, the Tri-Tac project office will report directly to the Assistant to the Secretary of Defense for Telecommunications. The major effort in FY 1972 will be development of a flexible, automatic digital switch capable of rapidly directing the flow of communications between or within forces.

For logistic support, the FY 1972 program contains $47 million for the Heavy Lift Helicopter. A sum of $20.5 million is requested for development in the Utility Tactical Transport Aircraft System program. For the final stages of development in the C–5A program, $26 million is included.

Tactical Air Warfare. The programs in tactical air warfare are divided into three mission areas:

- Deep strike/interdiction includes strikes by tactical aircraft and land-based missiles using conventional ordnance.
- Defense suppression includes ordnance to destroy, degrade, or suppress; countermeasures that degrade or confuse; and tactics and subsystems to avoid or confuse enemy air defense systems.
- Air superiority includes aircraft, weapons and avionics to win the classic air-to-air battle.

To provide an all-weather capability for *deep strike/interdiction,* funds are being requested in FY 1972 to complete research and development on the F–111 program, and for the A–6 TRAM (Target Recognition Attack Multisensor). Funds have also been requested to adapt sensors developed for Southeast Asia for use in high-performance attack aircraft like the A–6 to meet the need for improved weapons and weapon-delivery systems in our attack aircraft.

Funds in the amount of $19.9 million have been requested for the FY 1972 portion of the development and evaluation testing of the Condor. To reduce duplication of air-launched weapons, Walleye production has been terminated but the Hobo (EO Mark 84) will remain in production.

In response to our need for improved *defense suppression* techniques, $38.8 million is included in the FY 1972 RDT&E budget to improve and expand existing assets.

In the *air superiority* mission area, the FY 1972 budget provides for the continued development of the F–14, F–15 and the International Fighter aircraft.

For improved air-to-air weapons such as the Phoenix, Sparrow, AIM–9L, and Agile missiles, as well as for improved aircraft guns, the FY 1972 budget contains $49.5 million. There is also $27.8 million contained in the budget request for systems to improve pilot efficiency and effectiveness. These include the helmet-mounted sight, improvements in air-to-air identification, and training aids for air-to-air combat.

The FY 1972 budget request includes $145.1 for the Airborne Warning and Control System (AWACS). Also, $5.3 million is requested for improving the land-based Air Force Tactical Air Control System (TACS). For the joint Service program under the executive leadership of the Navy to provide the means by which the Tactical Air Command Systems/Tactical Air Direction Systems (TAC/TADS) are interoperable in the joint operational environment, the FY 1972 budget contains $4.9 million.

Strategic Forces

Several fundamental precepts influence DOD strategic planning and, in turn, DOD research and development efforts. The first precept is strategic sufficiency. In this context, there are several factors which DOD must take into account when planning forces to deter nuclear attack on the United States. These include:

- Maintaining an adequate second-strike capability to deter an all-out surprise attack.
- Providing no incentive for the Soviet Union to strike the United States first in a crisis.
- Preventing the Soviet Union from gaining the ability to cause considerably greater destruction than the United States could inflict in a nuclear war.
- Defense against major damage from small attacks or accidental launches.

The second precept relates to the matter of first-strike (or counterforce) capability. Specifically, this means the ability to use U.S. strategic forces to destroy the Soviet's deterrent by a first strike. It has been and remains U.S. policy not to seek such a capability.

In the Safeguard program, the President has requested the authority to continue with the presently approved three-site deployment and to do enough preliminary work to keep the option for proceeding with either the additional site at Warren AFB, Wyo., or advanced site preparation for defense of the National Command Authority at Washington, D.C. The choice of location of the fourth site would, thus, be deferred until more is known about the outcome of the Strategic Arms Limitation Talks (SALT).

In addition to defense of the Minuteman strategic force by the Safeguard system, the Upgraded Silo (UGS) Program provides for development of methods to increase the hardness of the present Minuteman silos. Funds amounting to $60.8 million are included in the FY 1972 budget for research and development under the UGS Program.

Initiation of a program to develop a modified form of ballistic missile defense, called Hardsite Defense, is being proposed to supplement Safeguard if necessary at an appropriate future time. The purpose of this program is to provide the capability to counter a future threat if all the new Submarine Launched Ballistic Missiles and multiple and improved Reentry Vehicles, under development by the Soviet Union, were also deployed. To initiate the first phase of the Hardsite Defense Program, $65 million is included in the FY 1972 budget.

The viability of our bomber deterrent will be greatly increased by development of the B–1. The B–1 will have improved penetration capabilities, in addition to greater pre-launch survivability. It will eventually replace the aging B–52.

In the bomber penetration area, based on favorable results of flight tests completed so far, a decision was made to proceed with production of the Short Range Attack Missile (SRAM) to provide capability against terminal defenses. For penetration of area defense, $10 million is requested to reinstate the development program on the Subsonic Cruise Armed Decoy (SCAD). Initial SCAD design will be for the B–52, with later modification kit adaptation to the B–1.

The sum of $109.5 million is included in the FY 1972 budget to continue development of the Undersea Long-Range Missile System (ULMS). Since the ULMS will not be available for some time, in the interim investigation of systems that could threaten the Polaris/Poseidon force and development of the best possible counters to them will continue. The FY 1972 budget requests $14.2 million for this purpose.

Survivable Communications. While continuing to maximize survivability and compatibility of the communication systems of the Minimum Essential Emergency Communications Net (MEECN), new systems that can be significantly more survivable than the current elements of the MEECN will also be explored.

In FY 1972, DOD will initiate the design and fabrication of experimental communication satellites that will demonstrate and validate the technology needed for attainment of satellite survivability.

Research and Technology

If we are to provide our national leaders in the years ahead with an adequate range of effective weapon alternatives from which to choose, we must maintain an adequate technology base today. We will, of course, build only a small fraction of the weapon systems of which we are capable, but we must ensure that reasonable options are available.

To do this, we are requesting $322 million for research and $1,006 million for exploratory development in FY 1972. These funds are requested to permit emphasis on four objectives in defense research and technology.

Subsystem Improvement. Many of our military systems would be more effective if technological advance could be achieved in subsystems where breakthroughs seem attainable. We propose to strongly support research and development in areas such as laser guidance, night vision devices, sensors, ocean surveillance, personnel armor, electro-optical seekers, and low-light-level television.

Maintenance of Research Excellence. Continued support is anticipated to research in a number of applied science fields related to the defense mission. Examples are meteorology, oceanography, biomedical sciences, materials, microelectronics, sensor technology, and computer sciences.

New Fields. New areas of applied science relevant to defense arise as science itself moves forward. Some of these areas planned for DOD support are:

- Chemical lasers.
- New medical methods (such as artificial skin for massive burns and wounds, immunization for parasitic diseases like malaria, and new techniques of monitoring wounded who are suffering traumatic injuries and shock).
- Advanced aircraft propulsion technology for V/STOL (vertical/short takeoff and landing).
- Computer instruction and output simplification.
- Armor.
- Human behavioral research relating to all-volunteer forces, with a view in particular to developing more effective educational methods and combating drug abuse.

Arms control agreements are being sought by this Administration. To be successful and realistic, they must be based on a sound technical understanding of what needs to be verified and the means to guarantee verification. Defense research and technology must contribute both to maintaining a military balance and to exploring the technical base for new initiatives in arms agreements.

Soviet/CPR Technology. Intelligence information of foreign technology, particularly that of the Soviets, often indicates directions and application different from that of the United States. Research and development in such areas provides important assessment of foreign capabilities and can also lead to useful applications for the United States. It is not our intention to match or excel each area of foreign technology. However, if we are to evaluate foreign efforts and assess the importance of any threat posed by foreign technology, DOD must have at least a technical analysis capability in those areas. Intelligence information is rarely complete enough by itself to provide a sufficient understanding of what we are faced with.

Management of RDT&E Program

The requirements of national security and the Soviet challenge to our technological leadership demand management of U.S. resources in the most effective and efficient manner possible. We can afford nothing less in view of the increasing differential between Soviet and U.S. military RDT&E expenditures.

In DOD, we have evolved specific mechanisms to help ensure that we formulate the right objectives and that the responsible people understand them clearly. These mechanisms include Development Concept Papers, Selected Acquisition Reports, the Defense Systems Acquisition Review Council, Area Coordinating Papers, Technology Coordinating Papers, and Management Reviews.

Prototype competition is another procedure which will be used to achieve development of better equipment. Contractors will be required to submit less paperwork, but they will be required to produce more hardware for test and evaluation. This procedure, we feel, will provide more reliable weapon systems.

We are adopting new mechanisms to define requirements and possible performance tradeoffs. We clearly could not afford to fund development of full-scale prototypes to resolve the uncertainties of major system concepts being considered. Instead, we will require fabrication, testing, and evaluation of critical components prior to final selection of the best concept and subsequent engineering development. Milestones will be established for major programs to govern future production decisions.

The military services have substantially strengthened their procedures for selection of system program managers to ensure that the best qualified personnel are given program management responsibility. Program milestones are used to identify the appointment and termination dates of program managers, thereby avoiding disruption of essential program management actions. Attention is being given to concentrating specific authority and responsibility with major system management teams, and affording the program manager direct access to the top if he needs help.

Planning is in progress to carry out the recommendations of the Blue Ribbon Defense Panel to give increased emphasis to research and advanced technology, engineering development, and test and evaluation.

Research and advanced technology will be given increased emphasis in the Office of the Director of Defense Research and Engineering to ensure that all areas of new technology applicable to national defense are being properly addressed. Procedures are being developed to deal with this broad area and to record the program to be executed by DOD.

In the area of engineering development, the military services will be expected to assume full responsibility for the conduct of weapon system development. The Office of the Director of Defense Research and Engineering will concentrate on purely managerial aspects of the engineering development phase. Emphasis will be placed on the functions of policy, planning and guidance in system acquisition, and evaluation of the progress toward meeting approved objectives of programs being managed by the military services.

Increased emphasis by the Office of the Secretary of Defense is being placed on testing and evaluation through the establishment of a Deputy Director of Defense Research and Engineering for Test and Evaluation. There will be more tests of weapon systems against opposing systems. The Weapon Systems Evaluation Group will be given an expanded role in operational test and evaluation.

Funds in the amount of $7.88 billion requested for RDT&E in FY 1972 cannot, in fact, match the challenge that the Soviets pose by their apparent RDT&E commitment of an equivalent of more than $10 billion annually. The DOD FY 1972 research and development budget will permit the start of a limited number of new programs in response to the most significant Soviet challenges, and will support the policy of realistic deterrence.

I am confident that all who are involved in the national defense effort will agree that, while increased funding is necessary, an equally vital factor in keeping our technological superiority is *increased efficiency.* To remain technologically ahead, we clearly need both. The problems we face demand our best efforts in the use of the available funds.

FY 1972 Defense RDT&E Program

Navy

Rear Admiral Edward A. Ruckner, USN

The Navy research and development program covers the broad spectrum of Naval requirements for weapons and systems to improve the capabilities of our operating forces to meet the challenge of today and of the future. To discuss the highlights of Navy research and development, it is probably most meaningful to group our effort in a series of functional areas or warfare areas as follows:

- Research and Exploratory Development.
- Air Warfare.
- Surface Warfare.
- Undersea Warfare.
- Strategic Warfare.
- Electronic Warfare, Communications.
- Command and Control.
- Marine Corps Programs.
- Space Programs.
- Management and Support.
- Ocean Science and Engineering Program.

Fiscal tables summarize the relationship between the FY 1971 and FY 1972 budgets for Research, Development, Test and Evaluation, Navy.

Research and Exploratory Development

In the Navy's research program, we have tried to strike a balance between in-house research and contract research.

Among the areas in which the Navy is working are research on the construction of very high-power traveling wave tubes; the effect of electromagnetic radiation on living tissue; and over-the-horizon radar.

As a joint effort between universities and the Navy Research Laboratory, we are studying the properties of intense electron beams which can be made to interact with magnetic fields so as to produce electromagnetic radiation in pulses of extraordinary power (possibly as high as 100,000 megawatts).

In exploratory development, we have limited our effort to those programs which appear to hold the most promise for future development. We are also emphasizing use of research and development models in the field where we can try out ideas in a realistic environment.

Air Warfare

Air warfare encompasses all naval operations carried out in the air except antisubmarine warfare.

The EA-6B airborne carrier-based electronic warfare aircraft is expected to provide significantly improved tactical jamming capability to the Fleet. The first production aircraft have been delivered to the Fleet. Development of tactics, intercept receivers, and jammers matched to new threats will continue in FY 1972.

The F-14A advanced fighter aircraft made its first flight in December 1970. During the second flight, a casualty to the hydraulic system resulted in loss of the test aircraft. Engineering action to correct the cause of the hydraulic systems failure is underway. It now appears that Board of Inspection and Survey trials will take

Navy Research, Development, Test and Evaluation Program, by DOD Categories

($000,000)

DOD Categories	FY 1971	FY 1972
Research	$ 116.9	$ 121.6
Exploratory Development	244.0	269.8
Advanced Development	311.1	492.1
Engineering Development	575.6	532.7
Management and Support	225.8	252.2
Operational Systems Development	722.7	738.7
Additional Supplemental & Amendment for Pay	12.7	24.3
Totals	$2,208.8	$2,431.4

place about the end of calendar year 1972 instead of in June as originally scheduled.

In order to improve the performance of the F–14 aircraft, we are continuing development of the advanced technology engine. Installation of this engine in the F–14 airframe, to be designated the F–14B, will provide about 40 percent more thrust. The advanced technology engine will be tested in FY 1972 in the first flight of an F–14B.

In January, our carrier-based airborne early warning/command and control system, the E–2C aircraft, had its first flight test in production prototype. System integration tests now being conducted show that all major subsystems are performing in a satisfactory manner.

Development of several weapon systems of importance will be carried out during FY 1972.

Tests are being conducted on the Phoenix missile and the AWG–9 missile control system, integrating it with other F–14 avionics. The system Integration Test Station at the Naval Missile Center, Point Mugu, Calif., will assure that all systems are satisfactory prior to installation in the F–14A aircraft.

The Agile, a short-range highly maneuverable passive air-to-air missile, is being developed by the Navy for use by both the Navy and the Air Force.

The Condor, an air-to-surface missile with TV guidance, can be launched from long ranges to hit high-value targets with extreme accuracy. The program now includes completion of thorough fly-before-buy tests before a production decision is made.

Defense Systems Acquisition Review Council (DSARC) approval for initiation of the development of the engineering design phase of the Harpoon ship/air-launched antiship weapon system has been received and a Request for Proposal has been forwarded to industry. To ensure operational utility demonstrations prior to the need for production decision, we will follow the design phase by a weapon system development prototype phase.

Surface Warfare

There are several programs for development of surface weapon systems which are of interest.

Eight small ships will be equipped with an antisurface capability using the Standard missile. Successful test firings from ships have verified the feasibility of such a system.

The Major Caliber Lightweight Gun has been undergoing live firing tests during the past year. We are also developing special ammunition which we expect to be able to fire to very long ranges using this gun.

We have just completed development of the new lightweight 5-inch gun, and are testing the accompanying MK 86 Gun Fire Control System.

One of the antiair weapons on which we will complete development is the Vulcan Phalanx Close-In Weapon System which has achieved impressive results in developmental tests.

Effort continues on the engineering development model of the Aegis system. It will be tested aboard the USS Norton Sound before we undertake procurement. Later ships of the DLGN–38 class are scheduled to receive this missile system. Installation of Aegis in DD 963 class destroyers, as well, will be feasible. Studies for variations in the Aegis system for other ship platforms are currently underway.

Although it involves the use of a helicopter, the LAMPS program is considered to fall in the surface warfare area. The objective of the program is to increase the capabilities of destroyer-class ships in areas of long-range classification, localization, and attack capability against submarines; enhancement of antiship missile defense; and provision for long-range targeting of the destroyer's own surface-to-surface missiles.

The LAMPS system will use the SH–2D aircraft and be configured with off-the-shelf components. We will make a program decision concerning the development and acquisition of a new helicopter at such time in the future as our sensor effort has proven out.

In ship design, there are two programs of major importance to the future of the Navy. We are developing 150-ton hydrofoil ships for use in the high-speed patrol craft mission. Our present 60-ton hydrofoil ships have been tested in actual operations in Southeast Asia. In FY 1972 we plan to commence test craft operations with contactor-conducted tests on the Surface Effect Ships (SES). These ships hold promise of large increases in surface ship capabilities over present hull types.

The Navy is currently going forward with the development of the Amphibious Assault Landing Craft. These air cushion vehicles will be capable of speeds up to 50 knots in a sea state 2 (waves to 3 feet, wind 7 to 12 knots) when fully loaded, and will carry the heaviest of Marine Corps equipment, including the 60-ton tank.

Undersea Warfare

The MK 48 Torpedo has the speed, endurance and depth capabilities required to cope with the latest nuclear submarines. As such, it is probably the most important development for our submarines. We are now engaged in a series of tests to determine which of two competing versions should be selected for quantity procurement. Westinghouse has developed the MK 48 Mod 0/2 and Clevite the MK 48 Mod 1. We expect to complete the technical and operational selection tests soon so that we can make the selection decision.

There are two important developments in the air antisubmarine (ASW) field. The fleet introduction of the P–3C, with a computer integrated information handling and display system and with the Difar sonobuoy capability, has added a new dimension to the capability of our air ASW forces. The first operational deployment of this system was in July 1970.

We are moving ahead in all aspects of development of the S–3A carrier-based ASW aircraft. For example, we have passed the 5,000-hour test mark for the TF–34 engine. We began test flying the engine in a B–47 aircraft test bed in January of this year. First flight of the S–3A is now anticipated sometime early in calendar year 1972.

In another area of undersea warfare we are developing the CAPTOR (enCAPsulated TORpedo) homing mine.

Strategic Warfare

The Navy's sea-based strategic warfare research and development programs have as their central theme the maintenance and continued development of an assured second strike potential.

We have had deployed for some years now the Polaris system. Recently the first Poseidon system became operational. To date our test firings of this C–3 missile have met major test objectives. Funds for FY 1972 in this program will be used to complete development of the MK–88 Mod 1 Fire Control System for installation in nuclear ballistic submarine 640 class conversions and subsequent.

Looking further into the future, we have been studying the Undersea Long Range Missile System (ULMS) since 1968. In FY 1970, we directed our effort to the submarine. We studied hull and ship subsystems, equipment maintainability, and manning. We devoted our FY 1971 effort to full configuration and subsystem design. We will continue in FY 1972 in this series of iterative steps toward the final design of the ULMS system.

In addition to the submarine and its load of strategic missiles, we must have an assured means of communications with these ships. One presently operational system is an airmobile relay very low frequency system, called TACAMO.

Another strategic communications system, project Sanguine, is a research system that would provide communication with a deeply submerged submarine through the use of transmissions in the extremely low frequency (ELF) range. System characteristics include all ocean coverage to strategic forces worldwide from a continental U.S. transmitter complex with high jamming resistance.

We have completed an ELF test facility in Wisconsin. During 1970, we verified that effects of a Sanguine electromagnetic field on power lines, telephones, television receivers, fences, and other man-made devices could be successfully mitigated. Compatibility with the environment has been a prime requisite of all systems and components under consideration.

Electronic Warfare, Communications, Command and Control

The first of two research and development versions of the modular electronic warfare system, Shortstop, has been installed at the Fleet Anti-Air Warfare Center, Dam Neck, Va., and is currently undergoing technical evaluation. The second research and development set is currently being installed aboard ship.

Evaluation aboard ship in the operating environment is considered essential before a decision is made to implement appropriate versions of this system in the Fleet. The FY 1972 research and development funds will support continuation of test development and test of this vital electronic warfare system.

The Navy and Marine Corps are pursuing several jamming and deception systems programs including, among others, the EA–6B dedicated jammer aircraft. Through current research and development, our deception jammer systems for use on all strike aircraft are being improved.

An automated system for communications traffic management, comprised of newly developed electronic equipment, will provide automated message processing and distribution to numerous remote locations within the nuclear attack carrier USS Nimitz.

To combat the ever increasing volumes of messages broadcast daily to fleet units, we have embarked on development of the General Address Reading Device (GARD) designed to screen the headings of all incoming broadcast messages and printing in full only those of interest to that ship.

Marine Corps Programs

Many of the Marine Corps needs are common to the Navy, Army, and Air Force, and so unilateral programs are undertaken only when planned de-

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velopments of other Services will not meet Marine Corps requirements.

The problem of accurately locating hostile mortars, rockets, and artillery so as to destroy them with counterfire is long standing. One development program in this field is a Polystation Doppler System. It is intended that this equipment will be developed jointly with the Army.

The Position Location Reporting System (PLRS) concept is a time-ordered system which will compute and continuously display three-dimensional locations of all ground and air units. Field tests are underway to further refine the concept. Hardware and software for the Marine Integrated Fire and Air Support (MIFAS) are being procured. In FY 1972, this subsystem will be evaluated in a test bed. Marine Tactical Command and Control System (MTACCS) is a subsystem of the future Marine Corps Command and Control System.

An associated program is the development of the Lightweight Three-Dimensional Ground Controlled Intercept Radar (Ltwt 3–D GCI Radar—AN/TPS–59). This helicopter transportable radar will provide the Marine Corps air command and control systems with three-dimensional, digital data concerning aircraft at long ranges and high altitudes.

The Laser Target Designation System (LTDS) equipment, which will enable aircraft to attack ground targets designated by a Forward Air Controller (FAC), has been evaluated in a combat environment.

The Night Observation Gunship (NOGS) is configured to satisfy a requirement for an attack aircraft, capable of interdicting enemy lines of communication (trails, roads, inland waterways, etc.) at night, under all weather conditions in both high and low antiair threat environments.

Operational evaluation of pilot production version of the Bulldog missile,

Navy RDT&E Budget FY 1972

($000,000)

RDT&E Program by Budget Activity

	Program FY 1971	Estimate FY 1972
MILITARY SCIENCES		
In-house laboratory independent research	$ 13.5	$ 13.7
Defense research sciences; Navy	104.5	110.0
Center for Naval Analysis, Marine Corps	.9	1.0
Center for Naval Analysis, Navy	6.8	8.6
Studies and Analyses; Marine Corps	2.0	2.2
Studies and Analyses; Navy	9.5	9.2
Total Military Sciences	**$136.9**	**$144.8**
AIRCRAFT AND RELATED EQUIPMENT		
Aircraft	$ 18.1	$ 19.6
Airborne antisubmarine warfare detection	6.1	15.1
Avionics	1.6	1.6
V/STOL developments	.7	1.5
Air/Surface fire control	3.1	2.2
Environmental experiments	2.0	2.2
Advanced airborne reconnaissance	.4	—
Advanced aircraft propulsion system	—	7.5
Destroyer helicopter system (LAMPS)	3.6	38.5
Airborne life support system	.7	.5
Carrier antisubmarine warfare tactical support center	—	1.2
Avionics development (VAST)	2.0	3.0
Target development	3.9	—
Laser target designator	3.1	—
Trim/combined sensor vehicle system	2.1	—
F–14B	63.3	100.2
Crane helicopter lift	10.0	.1
Aircraft handling and servicing equipment	1.0	1.6
Environmental modification system	1.0	1.0
Airborne antisubmarine warfare developments	9.6	6.7
Visual target acquisition and identification and weapon control system development	—	5.0
F–14 squadrons	274.0	128.0
Early warning aircraft squadrons (E–2C)	58.5	30.9
S–3A aircraft development	265.5	207.3
EA–6B aircraft	12.0	15.0
Directional Jezebel sonobuoy system	—	—
Improved follow-on light attack aircraft (A–7E)	—	—
Aircraft propulsion evaluation, general	3.7	4.9
Aircraft flight test general	4.3	5.5
Total Aircraft and Related Equipment	**$763.2**	**$640.2**
MILITARY ASTRONAUTICS AND RELATED EQUIPMENT		
Navigation satellite	$ 2.2	$ 4.2
Very low frequency (VLF) propagation satellite	.2	—
Navy navigation satellite system improvement	3.0	—
Mapping, chart, and geodesy (ANNA)	.4	.4
Satellite communications	9.0	16.4
Total Astronautics	**$ 28.7**	**$ 49.6**
MISSILES AND RELATED EQUIPMENT		
Missile propulsion	$ 9.6	$ 12.0
Strike warfare weaponry	26.4	—
Long-range surface weapon system	—	—
Advanced antiradiation missile system technology	1.1	—
Advanced air launched air-to-air missile system (AGILE)	8.6	—
Advanced air launched air-to-surface missile system	2.6	—
Advanced fuse design	2.2	—
Advanced sea-based deterrent	—	—
Submarine Tactical Weapon Systems (STAM)	—	—
Air Launched/surface launched antiship missile (Harpoon)	18.7	36.4
Advanced antiradiation missile weapon system	—	5.0
Sea-based ballistic missile defense	—	—
Point defense system development	19.0	—
3T major systems development	16.4	31.7
Advanced surface missile system (AEGIS)	72.0	100.0
Underseas long-range missile system (ULMS)	45.2	111.3
Pacific missile range	60.3	67.5
Missile/weapon systems test instrumentation	3.3	4.0
Fleet ballistic missile system	103.9	39.1
FBM command control	15.8	15.1
Antiballistic missile support	5.1	—
Condor	23.8	19.9
Advanced Sparrow	1.5	—
Phoenix missile system	8.8	3.7
Surface missile system program	8.0	—
Shrike	1.0	—
Standard Arm	2.5	—
Basic point defense missile system	1.5	—
Total Missiles and Related Equipment	**$469.2**	**$565.0**
ORDNANCE, COMBAT VEHICLES AND RELATED EQUIPMENT		
Undersea warfare weaponry	$ 16.9	$ 18.0
Marine Corps weaponry and vehicles	2.4	3.1
Advanced mine development	11.8	—
Antisubmarine warfare torpedo countermeasures resistance	.5	—
Sub-launched antiship torpedo	—	—
Advanced biological warfare/chemical warfare weapons	—	—
Advanced conventional ordnance	2.7	—
Advanced Marine Corps weapon systems	2.5	2.2
Surface-launched munitions	2.4	—
Mine warfare development	—	—
Unguided conventional air-launched weapons	4.7	—
Biological warfare chemical warfare weapons	—	—
Conventional ordnance equipment	4.8	—
Marine Corps ordnance combat vehicle system	1.5	1.2
MK–48 torpedo	42.1	21.1
Modular guidance weapons improvement	.6	3.1
Total Ordnance Combat Vehicles and Related Equipment	**$ 97.9**	**$ 99.3**

a modified AGM–12B Bullpup which can home on targets, will be conducted in FY 1972. Of the first five weapons tested, four made direct hits.

Space Programs

One of the more important aspects of the Navy Space Program is our work with communications satellites.

During communications satellite experiments completed last spring, we demonstrated successful communications in helicopter operation from an amphibious assault ship (LPH), between destroyers during maneuvers, during aircraft launch and recovery operations aboard an aircraft carrier, and from shore to a TACAMO (strategic communications) aircraft. UHF fleet broadcast was demonstrated using the LES–6 satellite during cruise of the USS Providence (CLG–6) from Tahiti to San Diego.

Management and Support

This functional area includes several diverse programs. We conduct investigations to assist in Navy planning under the Center for Naval Analyses and the Studies and Analyses Programs. At the other extreme, we provide for routine operations of the Pacific Missile Range, the Atlantic Undersea Test and Evaluation Center, and other RDT&E activites at other Navy facilities and installations. In addition, there are programs included in the Navy RDT&E budget providing for management and technical support of ASW and strategic warfare.

Ocean Science and Engineering Programs

The programs conducted in the supporting function of ocean science and engineering do not result in specific weapon systems but may contribute to the successful development and use of such weapon systems.

The Bathyscaph Trieste II, for-

SHIPS AND SMALL CRAFT AND RELATED EQUIPMENT		
Nuclear propulsion	$ 19.8	$ —
Ships, submarines and boats	16.5	18.2
Reactor propulsion plants	32.0	—
Advanced mine countermeasures	1.2	—
Advanced submarine sonar	5.5	—
Advanced surface ship sonar developments	2.3	—
Acoustic countermeasures	—	—
Antisubmarine warfare ship integrated combat system	1.6	.6
Marine gas turbines	4.0	5.0
New ship design	7.5	12.2
Advance surface craft	11.0	13.7
Aircraft launching and retrieving	2.6	2.0
Shipboard system component development	1.9	.8
Shipboard damage control	2.5	3.2
Advanced identification techniques	1.0	2.2
Radar surveillance	.3	.5
Ship interior communication	.7	—
Advanced navigation development	1.0	2.4
Advanced command data	2.5	2.6
Advanced communications	2.9	.5
Advanced submarine surveillance equipment program	2.0	—
Subsystem reliability	.6	—
Operational performance data system	—	—
Heavy 130 steel	4.4	—
Advanced shipboard satellite readout equipment	1.0	—
Surface effect ships	13.0	39.6
Advanced ship/submarine sonar development	—	—
Mine surveillance and destruction system	—	—
Advanced antisubmarine warfare communications system	3.9	10.8
River and shallow water warfare	5.0	—
Radar surveillance equipment	.2	—
Communications systems	5.2	1.5
Electronic warfare systems	—	—
Electronic warfare quick reaction capability	—	—
Navigation systems	1.3	1.0
Submarine surveillance equipment program	—	—
Electric powerplants	.6	.5
Joint advanced tactical command, control and communications program	2.5	2.0
Combat information center conversion	.8	1.4
Ship antimissile integrated defense	—	—
Antisubmarine warfare acoustic warfare	—	—
Western Pacific north air defense compatibility program	.6	—
Fleet escort (Major)	.6	.6
All weather carrier landing system	.6	.7
Sonar AN/SQS–26	3.2	2.2
Omega	—	—
Technical sensor collection	—	—
National military command system—systemwide support	.1	.4
Total Ships and Small Craft	$339.9	$493.4

OTHER EQUIPMENT		
Life sciences	$ 6.7	$ 9.4
Environmental support	21.2	22.1
Laboratory independent exploratory development	11.2	11.8
Material support	11.7	15.9
Materials and components	17.5	25.3
Personnel support	6.3	8.0
Chemical biological weapons/defense	1.0	—
Undersea target surveillance	24.6	—
Surface aerospace target surveillance	8.1	—
Command and control	13.4	12.6
Countermeasures	9.7	9.6
Other exploratory development	1.9	2.5
Ocean engineering systems development	5.0	5.0
Oceanography instrumentation development	2.1	.6
Advanced logistics	2.5	—
Advanced medical development	3.0	3.1
Manpower effectiveness	1.3	2.1
Training devices technology	—	—
Advanced marine biological system	1.6	1.7
Other Marine Corps advanced development support	7.0	6.4
Ocean engineering technical developments	10.3	10.5
Electronic intercept system	—	.8
Integrated ocean surveillance information system	1.0	2.2
Minimum essential emergency communications network	1.0	—
Education and training development	2.4	3.3
Antisubmarine warfare force command control system	1.5	—
Training devices prototype development	.9	.9
Other Marine Corps systems	5.1	9.7
Navy special warfare	—	8.0
Remote unattended sensors	.2	2.0
Antisubmarine Warfare Environmental Prediction Services (ASWEPS)	.9	.5
Marine Corps Joint Interface Program	—	.6
Marine Corps tactical data system	1.7	1.1
Marine Corps operational logistics development	.5	.4
Marine Corps operational electronics development	3.5	1.5
Navy communications system modernization	.7	—
Total Other Equipment	$227.0	$274.6

PROGRAMWIDE MANAGEMENT AND SUPPORT		
Facilities and installation support, including defense agencies	$114.3	$125.3
Atlantic Undersea Test and Evaluation Center (AUTEC)	14.9	16.2
Electromagnetic compatibility and effectiveness	1.0	1.0
Technical information centers	1.5	1.1
International cooperative research and development	.2	.3
Antisubmarine warfare management and technical support	8.5	14.5
Strategic operational weapon systems management and technical support	2.0	3.0
Special laboratory support	3.4	2.9
International military headquarters and agencies	.3	.3
Total Management and Support	$146.0	$164.5
Total Navy RDT&E	$2,208.8	$2,431.4

merly certified to operate at depths of 12,000 feet, has been recently redesigned to be capable of operating to 20,000 feet. The Deep Submergence Rescue Vehicle (DSRV–1), launched in January 1970 at San Diego, will be capable of rescuing personnel from submarines to depths of 3,500 feet. It made its first dive in October 1970. DSRV–2 was launched May 1971.

During FY 1971, service tests were completed on the MK I Deep Dive System which provides diver support at the work site, and the MK XI breathing apparatus, an improved, deep depth, SCUBA-type device. This equipment provides the Navy with the capability of working dives over the entire continental shelf.

The Location Aid Device (LAD), a device used for marking location of high-value objects accidentally dropped in the sea, has been offered to the Federal Aviation Agency in response to its requirement for equipping all commercial aircraft flight recorders with a location beacon.

The National Oceanographic Data Center and the National Oceanographic Instrumentation Center were transferred from the Navy to the National Oceanic and Atmospheric Agency (NOAA), which has primary responsibility for prosecuting oceanographic and meteorological programs in the civilian sector.

The foregoing, while addressing only the more important aspects of the Navy RDT&E budget for FY 1972, offers an insight into the range and scope of programs included therein.

FY 1972 Defense RDT&E Program

Air Force

Lieutenant General Otto J. Glasser, USAF

The strategy of realistic deterrence is the keystone of the defense posture for the 1970s. In order for the Air Force to have the capability to fully support this strategy, it is necessary to improve our force through modernization and development. The basic foundation for doing this is more effective management of our research and development programs.

Deputy Secretary of Defense David Packard recognized this and has said: "If we are to maintain forces that ensure Realistic Deterrence even with lower budget levels, if we are to improve our military capability even with lower force levels, then the most important contribution we can make toward better capability is to increase the effectiveness of our Research and Development program."

Significant changes have been made in DOD policies which govern the development and acquisition of weapon systems and which reflect the effort to increase effectiveness. These important changes should result in a significant reduction in paper work and allow the military services time to pay more attention to the important tradeoffs that can be made between technologies, costs, schedules, and operational requirements.

Within the frameworks of these new policies, the Air Force has made progress toward improving management procedures. Considerable effort has been spent to eliminate unproductive, duplicative, or marginally useful work and to generally improve management procedures.

The Air Force has provided a closer coupling of research, advanced technology, and systems development through the merger of the Office of Aerospace Research into the Air Force Systems Command. New system program office procedures have been implemented that will, in addition to others, allow most systems development decisions to be made at much lower levels of command. Procedures have also been established to coordinate system requirements and development efforts more closely with the other Services.

In one approach to innovative management, the Air Force is giving careful consideration to the idea of prototyping aircraft—building experimental models which are not necessarily intended for production for operational service. The purpose of these prototypes is to assist us in developing new subsystems, unique designs, and occasionally complete systems. Such an approach would provide us with tested new techniques and equipment for application to future aircraft or aircraft modifications. As a payoff, we would not only have the technology in hand for new systems, but also new techniques and equipment that have been engineered and tested. I believe that a small investment in this prototype approach to development will in the long run pay handsome dividends by reducing the risks and cost involved in developing new systems.

These are but a few of the steps being taken by the Air Force to implement DOD policies. These steps have improved management and are contributing to increased effectiveness of our research and development program.

The proposed Air Force Research, Development, Test, and Evaluation (RDT&E) program for the uncoming year totals $3 billion. This is a limited budget and many programs that would certainly have enhanced the Air Force's capabilities had to be cancelled or delayed. It has been necessary to make the best allocation of funds among requirements for the development of new systems, modernization of existing systems, and support to our technology programs for the future.

Bomber and Airlift Forces

This year, as in past years, a sizable percentage of our total RDT&E budget request is for development of

Air Force Research, Development, Test and Evaluation Program, by DOD Categories

($000,000)

DOD Categories	FY 1970	FY 1971	FY 1972
Research	$ 85.3	$ 85.2	$ 86.9
Exploratory Development	240.7	236.3	255.2
Advanced Development	340.8	335.7	365.9
Engineering Development	479.7	629.6	1,025.2
Management and Support	624.2	603.8	468.5
Total Research and Development Program	1,770.7	1,890.6	2,201.7
Total Operational Systems Programs	1,310.1	928.6	815.3
Total Research, Development, Test and Evaluation Program	**$3,080.8**	**$2,819.2**	**$3,017.0**

new and improved strategic weapon systems. Systems are being planned for the B–52s. We are also developing systems which can ultimately be inherited by the proposed B–1.

One of the systems is the Short Range Attack Missile (SRAM). It is designed to give us the capability to attack targets defended by surface-to-air missiles. The SRAM development program is nearing completion now and overall test results, at this time, clearly show it is a very successful missile. The B–52/SRAM flight test program has been successfully completed, and the FB–111/SRAM test program will be finished shortly. The small FY 1972 RDT&E budget request for SRAM is required only to complete the contract reports, finish some minor related test efforts, and settle outstanding contract obligations.

The Subsonic Cruise Armed Decoy (SCAD), with improved range over the Quail, is being developed to more effectively simulate bomber target return.

The development approach to SCAD places primary emphasis on demonstration of the decoy package. Development and test of critical SCAD components are now in progress. The initial advanced development efforts have been successful, and full-scale development of SCAD is being advocated as a decoy for the B–52, with growth potentials for arming and later modification as a decoy for the B–1.

With the SRAM and SCAD in service, today's bomber force should remain effective at least through the late 1970s. However, the point has been reached where the option to deploy a new bomber with improved basic performance and characteristics must be provided. As a result, development of the B–1 bomber is the most important strategic program. In June of last year contract awards were made to North American Rockwell and General Electric as B–1 system and propulsion contractors, respectively.

Within the B–1 program, an innovative management approach has been adopted to minimize funding prior to a production decision to go ahead with the system. The number of flight test aircraft was cut from five to three, the number of engines for test has been reduced, and other changes have been made to reduce costs. With these changes in the B–1 development program, the first flight is planned for April 1974.

The requested FY 1972 B–1 funds will be used to continue RDT&E activities toward the system and engine critical design review milestone scheduled for mid-1973. The preliminary design review will be held this summer, with the mock-up review about four months later. Critical component test efforts will begin for the aircraft and the engine at that time, and the remaining 50 percent of the B–1 specifications will be released.

The budget request for airlift programs is very small, with C–5A being the only system requiring RDT&E funds.

Because of the wing crack problem that was discovered in 1969, the Secretary of the Air Force had a complete technical review of the C–5 performed by the Air Force Scientific Advisory Board. A fix has been tested and installed for the wing crack problem, and structural static testing is expected to be completed in August 1971.

Missile Force

Just as the bomber force is being updated so is the missile force. The primary programs in this area are continued work on Minuteman III and upgrading the missile silos.

In the past year, the Minuteman III development flight test program was completed as planned, and the

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results confirmed the soundness of the missile design. In addition, initial operational capability for the Minuteman III was achieved last June. The primary efforts during the next year will be continued deployment of Minuteman III, and design and development of further silo upgrading improvements for added protection against nuclear effects.

The Minuteman rebasing program was established to evaluate and compare all of the proposed Minuteman survivability improvements, and to ensure that the Minuteman force retains its current high pre-launch survivability. As a result, an evolutionary silo upgrading program to assure long-term viability of land-based ICBMs was developed. This upgrading is achieved by capitalizing on the inherent hardness of the existing silo structure and by other modifications. The program is planned to coincide with the Minuteman force modernization program to avoid duplications of costs.

After completion of the upgrade silo program, the pre-launch survivability of the Minuteman force will be improved. Future improvements to the U.S. intercontinental ballistic missiles force are being studied under the new advanced missile options program. The basic step of gaining a better understanding of the operational considerations, costs, risks, and other key elements of these concepts will be taken next year. Better resolution of these uncertainties is needed before consideration can be given on expanding significant funds.

Defensive Systems

The programs that have been covered are designed to increase our strategic deterrent and retaliatory standing. At the same time, our national defensive capability must be updated.

The major improvement needed in this area is an increase in the warning time in case of an enemy bomber or sea-launched ballistic missile attack. To ensure that there will be early warning, the development of three systems will be continued: an Over-The-Horizon (OTH) backscatter radar system; and Airborne Warning and Control System (AWACS); and

Air Force RDT&E Budget

($000,000)

	Program FY 1971	Estimate FY 1972
MILITARY SCIENCES		
In-house laboratory independent research	$ 5.0	$ 5.3
Defense research sciences	80.2	81.6
Environment	6.7	7.5
Materials	23.5	25.0
Preliminary design and development	6.1	5.1
Innovations in training and education	5.0	4.2
Air Force project RAND	11.0	11.0
Analytic Services, Inc. (ANSER)	1.5	1.5
Total Military Sciences	**$139.1***	**$141.2**
AIRCRAFT AND RELATED EQUIPMENT		
International fighter aircraft (F–5E)	$ 9.2	$ 48.0
FB–111 squadrons	16.3	—
SR–71 squadrons	2.0	—
A–7 squadrons	1.5	—
F–111 squadrons	48.2	19.2
Aerial targets	.6	—
C–5A airlift squadrons	11.6	26.0
Aerospace flight dynamics	31.8	34.2
Aerospace biotechnology	17.8	19.8
Aerospace propulsion	27.6	28.4
Aerospace avionics	44.9	48.2
Aircraft propulsion subsystem integration	8.0	6.1
Avionics for navigation/guidance/ weapon delivery	15.4	14.5
Flight vehicle subsystem concepts	18.8	19.4
Advanced fire control/missile technology	.5	—
Advanced reconnaissance and target acquisition capability	2.5	2.7
Aerospace structural materials	9.6	9.4
V/TOL engine development	3.5	—
Advanced turbine engine gas generator	8.0	13.7
Subsonic cruise armed decoy	—	10.0
National clear air turbulence program	.8	—
Advanced aerial target technology	4.0	4.2
F–4 avionics	13.1	7.7
F–15A	347.5	414.5
A–X aircraft	27.9	47.0
Aircraft equipment development	11.3	9.5
B–1	75.0	370.3
Reconnaissance drones	—	1.5
Total Aircraft and Related Equipment	**$757.4**	**$1,154.3**
MISSILES AND RELATED EQUIPMENT		
Short range attack missile (SRAM)	$ 56.5	$ 12.0
Minuteman squadrons	273.2	186.6
NIKE targets	7.0	—
Rocket propulsion	22.3	20.7
Advanced ICBM technology	6.0	8.4
Advanced ballistic re-entry system (ABRES)	100.0	86.7
Strategic bomber penetration	1.0	2.1
Advanced missile options	—	7.0
Tactical air-to-ground missile (Maverick)	27.9	7.5
Short range air-to-air missile	7.0	—
Hound Dog II	6.0	12.1
Western test range	69.3	68.9
Eastern test range	125.8	—
Western test range (defense communications support	.7	.9
Eastern test range (defense communications support)	.4	—
Total Missiles and Related Equipment	**$703.1**	**$412.9**
MILITARY ASTRONAUTICS AND RELATED EQUIPMENT		
Aerospace defense	$ 89.9	$ 41.3
Defense system applications program	8.8	5.3
Defense satellite communications system	6.7	—
Military satellite communications system	—	8.6
Special activities	172.8	212.2
Satellite control facility	35.1	34.8
Titan III space booster	28.5	2.3
Satellite control facility (Defense communications support)	2.2	2.2
Space vehicle subsystems	11.4	12.6
Space experiments support (SESP)	16.4	16.8
Satellites, balloons and rockets	2.0	1.6
Advanced liquid rocket technology	3.6	1.6
Tactical satellite communications	1.0	—
Advanced space delivery systems	2.5	3.0
Satellite system for precise navigation	2.0	5.9
Advanced surveillance technology	11.8	16.9
Missile and space defense concepts	1.8	.5
Aerospace support program	13.3	37.8
Survivable satellite	—	6.0
Aerospace defense program	—	10.0
Aerospace	19.5	15.0
Total Military Astronautics and Related Equipment	**$429.2***	**$434.4**

a Satellite Early Warning System.

Each of our Over-The-Horizon backscatter radar sites must have the capability to detect approaching bombers anywhere within their sector of coverage. Because of recent program developments, consideration is being given to changing the procurement from a contract definition approach to a building block approach. With this approach, the sites would be operational in the mid-1970s.

With the presently proposed system, there will be a surveillance gap. If the tests being conducted of further Over-The-Horizon operations show that additional OTH systems will not be practical, the existing radars could be supplemented with AWACS aircraft.

The AWACS is one of our high priority strategic and tactical programs. In its strategic defensive role, AWACS will offer a survivable early warning surveillance and battle management system to detect enemy forces hundreds of miles from U.S. borders at all altitudes. It will be capable of directing interceptors into battle positions sufficiently removed from the U.S. borders to engage enemy bombers prior to release of their air-to-ground missiles.

The AWACS program is a good example of the fly-before-you-buy concept. In this case, it has been initiated in the major segments of a program when we could not apply it to the whole program. The airframe for the AWACS will be a military version of the commercial Boeing 707 aircraft. For the radar subsystem, however, there is competitive development between two companies. Hughes Aircraft Co. and Westinghouse Electric Corp. are now building brassboard prototypes of their radars to be used in test flights. The radars are expected to be ready for installation in the test bed aircraft in January 1972. After four months of test flights, the better of two will be selected for development of the total system.

The third defensive system, the Satellite Early Warning System, is being designed to have capability to detect missile launches and nuclear bursts. The submarine-launched ballistic missile is the greatest threat to the pre-

OTHER EQUIPMENT		
Post attack command and control (PACCS)	$ .7	$ —
Emergency rocket command system (ERCS)	2.8	.3
Airborne warning and control system (AWACS)	87.0	145.1
CONUS over-the-horizon (OTH) radar system	5.3	3.6
Over-the-horizon (OTH) radar	3.0	1.1
Tactical air control system	3.5	5.3
Defense communications planning group	14.0	—
Technical sensor collection	—	.1
Intelligence data handling system	1.0	1.2
Special reconnaissance vehicles	6.0	5.4
Air Force communications	.7	.8
Air Force communications (Defense communications support)	1.8	1.4
Traffic control, approach and landing system (TRACALS)	6.5	2.5
Command	.2	—
Laboratory independent exploratory development	—	5.4
Ground electronics	37.5	39.9
Human resources	4.4	5.1
Over-the-horizon radar technology	1.5	1.6
Advanced tactical command and control capability	5.0	4.2
Satellite communications terminals—tactical	1.1	—
Airborne satellite communications terminals—strategic	1.3	.6
Loran D	8.6	.5
Base security	1.6	1.1
Reconnaissance/intelligence	4.2	4.7
Force protection subsystem concepts	12.0	12.6
Simulator for air-to-air combat	—	4.2
Aerospace facilities technology	3.3	2.6
Integrated communications-navigation-identification	1.5	.5
Data processing hardware/software technology	1.0	1.1
Advanced detection systems development	7.0	7.4
Support of minimum essential emergency communications network (MEECN)	2.0	2.8
Reconnaissance drones	—	.5
Ground based sensor technology	—	1.9
Defense suppression	—	16.1
Air-to-air identification of non-cooperative targets	—	4.0
Electro-optical warfare	—	5.0
Tactical information processing and interpretation	2.5	8.5
Air traffic control radar beacon system/air identification Mark XII system	.8	.5
Joint advanced tactical command control and communications program	1.0	1.1
Life support system	5.5	6.3
Other operational equipment	9.9	9.5
Lightweight precision bombing	5.0	5.3
Intelligence/reconnaissance equipment	9.0	10.5
Systems survivability	3.1	3.1
Improved aircraft firefighting equipment	.5	.5
Integrated program for air base defense	—	.6
Sensors for weather reconnaissance aircraft	1.0	4.2
Cobra mist	13.0	6.4
Mapping, charting, and geodesy	2.0	1.1
Common mobility support equipment	1.4	2.1
Advanced airborne command post (AABNCP)	2.0	—
Tactical LORAN	—	3.4
Ground-based sensors development and testing	—	2.0
Improved capability for operational test and evaluation	—	5.0
Foreign weapons evaluation	—	2.0
On board sensors	—	3.0
Protective systems	32.0	31.5
Information analysis center	1.9	—
Electromagnetic compatibility analysis center (ECAC)	5.6	5.0
Lincoln laboratory	19.5	18.0
MITRE	9.0	8.5
Aircraft navigation system verification	1.0	1.1
Total Other Equipment	**$361.8***	**$439.2***
ORDNANCE, COMBAT VEHICLES AND RELATED EQUIPMENT		
Advanced weapons	$10.3	$11.1
Conventional munitions	9.3	9.9
Conventional weapons	25.4	14.0
Advanced radiation technology	18.7	28.1
Chemical-biological defense equipment	.5	.5
Armament/ordnance development	9.7	10.6
Improved aircraft gun systems	10.5	21.4
Truck interdiction	4.5	—
Total Ordnance, Combat Vehicles and Related Equipment	**$88.8***	**$95.6**
PROGRAM-WIDE MANAGEMENT AND SUPPORT		
International military headquarters and agencies	$ 1.1	$ .8
International cooperative, research and development	.3	.3
Arnold Engineering Development Center base costs	7.7	12.5
Development and test support (Flight test center, Missile development center, Special weapons center, Armament development center)	143.0	133.5
Acquisition and command support (Aeronautical systems division, Electronic systems division, Space and missile systems organization, Aeromedical division, Headquarters, Air Force systems command)	187.2	191.7
Acquisition and command support (Defense communications support)	.6	.6
Total Program-wide Management and Support	**$339.8***	**$339.4**
Air Force Total RDT&E	$2,819.2	$3,017.0

* **Numbers do not add due to rounding.**

launch survivability of our bombers, but the earlier warning time provided by the new system would be sufficient to allow most, if not all, of the bomber alert force to be launched before impact of an incoming weapon.

Tactical Force

In the tactical area, the largest and highest priority program is the continuing development of the F–15 fighter aircraft. It will be equipped with a balanced mix of air-to-air weapons to provide close-in visual and medium-range, all-weather kill capability.

The F–15 airframe contract was awarded to the McDonnell Douglas Corp. in January, and the engine contract to Pratt & Whitney in March of last year. Hughes Aircraft Co. received the attack radar contract in September 1970, culminating 22 months of competitive development, including a radar "fly-off."

The F–15 program was the first to be changed substantially from a management standpoint. A "milestone" approach was adopted about two years ago, requiring major scheduled efforts to be completed before moving on to the next phase. Activity in the F–15 program will expand during the next year. The first flight is scheduled for next summer.

Also continuing to be developed is the A–X designed to be a truly specialized close air support aircraft. The A–X is being designed for maneuverability, long loiter time, a large payload, high survivability, and easy maintainability. All aspects of the A–X design reflect the projected heavy ground fire environment expected in late 1970s.

Again, in line with the policy of using the fly-before-buy concept, it is planned to procure prototype A–X aircraft from two different manufacturers. A–X prototypes—being built by Northrop Corp. and Fairchild-Hiller Republic—will be essentially completed and ready for a "fly-off" competition by summer. This development approach for the A–X is intended to assure having a proven aircraft at reasonable cost before commitment to production is made.

To provide an effective close air support weapon for the A–X as well as other aircraft, there will be a competitive shoot-off in the 30mm aircraft gun program. This program includes development of the gun, feed system, and combat rounds, as well as a pod to be used on the F–4 and A–7 aircraft. Two contractors are being selected for a two- to three-year competitive program to develop this new, high performance gun.

In addition to gun systems, tactical missiles will also be developed. The Maverick missile, designed for destruction of small, hard-to-destroy targets such as tanks, armored vehicles, and field fortifications, has a high probability of hitting its target and causing catastrophic damage. Through the end of March 1971, 24 successful Maverick flight tests were completed. Maverick's accuracy, combined with its launch and leave capability, should provide a marked reduction in risk involved in attacking small, hard-to-hit targets in hostile environments.

As mentioned earlier, effective command and control is needed.

AWACS, in its tactical role, will add an airborne element to the current ground-based Tactical Air Control System. It will add a capability for interim command of battle situations during the first 72 hours of a contingency. It will extend the radar and communications coverage of the existing control system installations deep into enemy territory, provide low-level coverage where such coverage is denied to ground systems due to line-of-sight limitations, and serve as a backup for any ground tactical control system installation put out of operation by enemy action. Because of the long-range capabilities of its equipment, the AWACS will do this while remaining behind the forward edge of the battle area.

Technology Programs

The importance of technological efforts to the future cannot be overstressed. It is necessary to diligently engage in the pursuit of new knowledge and the applications of that knowledge. The need for technology is based on the simple fact that today's technology is the basis for tomorrow's systems.

The technology program includes not only research and exploratory development but all those advanced development programs in which the work is non-system oriented. For example, our advanced ballistic re-entry systems, advanced turbine engine gas generator, advanced radiation technology, and systems survivability programs are all technology programs. These, along with the research and exploratory development programs, establish the total technological base. It is this base that must be continually built if technological surprises are to be avoided and if viable first-line weapon systems are to be developed in the future.

Several management actions have been taken with respect to research and technology programs in the past year or two. These actions will provide tighter control over these programs and ensure that each individual program has an identified set of specific goals.

In formulating the FY 1972 budget request it was difficult to decide how best to allocate funds between the development of weapon systems and the effort devoted to technology. However, the best possible balance between these requirements has been reached.

In summary, two points should be made. First, the RDT&E budget request for the next fiscal year does not include funds for many of the systems for which the Air Force has a valid and documented need. With current research and development funding levels, these systems simply could not compete with more pressing requirements such as the B–1, F–15, and Minuteman III.

Second, the Air Force has put forth an immense effort to improve management procedures. Under the new policies of the Defense Department, the Services have much greater latitude, which is essential for effective and efficient development and acquisition programs. More innovative management changes, such as the B–1 program will be forthcoming. A great deal more operational capability must be acquired for every research and development dollar spent.

A Progress Report: DOD Standard Data Element and Data Code Program

Mildred L. Bailey

In all data systems, whether they are industry's, DOD's, or mutual data systems, intercommunication of data is one of the biggest problems in providing useful, meaningful information to management at all levels. The problem of intercommunication in data systems exists on several levels—hardware, programming languages, coded character set, media formats, system design. However, the real root of the data communication problem lies in the expression of data itself.

To *consolidate* information from industry with that of the Federal Government, or from one government agency with that of another, or from one DOD organization with that of another, and end with a meaningful result or report is far from simple. Nor is it simple for two or more organizations to *interchange* data or feed data into a common data bank. The many complex information systems of industry, the Federal Government, and DOD use identical, similar, or related data that are described, identified, and coded with great variety. These differences inhibit or prevent reliable data banking, cataloging, retrieval, aggregation, and interchange of data without extensive and costly translation.

Integration of data systems, maintenance of unstructured data banks, and aggregation and exchange of data on an expanding scale has been made possible by technological advances in computers, communications, and allied fields. These advances have contributed to substantial cost reductions and improvements in systems and services. However, the full effect of these advances will not be realized until the need for uniform understanding (definition) of the common information (data elements) and expression of them (codes) in data systems is recognized and a means provided to develop and apply desirable standards. Increasing interrelationships developing among the data systems of industry, DOD, and other official and public organizations add emphasis and dimension to this need.

There are innumerable examples where DOD data systems (both related and unrelated) have developed different codes for the same meaning, the same terms (data elements) with different definitions, and the same definitions with different terms (data elements). To illustrate the problem in code development, the expression, "Materiel Condition," when reported in 13 different systems as "new," "used," "repairable," uses the structure shown in Figure 1.

Computer technology and high-speed communications systems allow integration of several of these systems to provide coordinated information for decision making on a very rapid response basis. However, integration can only be successful if the systems are designed for explicit and symbolic agreement. In the illustration given in Figure 1, the tool for system integration—standard data elements and their related codes—is missing.

In another example of non-standard code development, the term or data element, "unit," is used in two different contexts with the same breakdown into subunits, using different codes in two different systems:

	Unit of Issue	Unit of Measure
Gallon	GL	GA
Pack	PK	PA
Package	PG	PK
Hundred	HD	CS

Use of different terminology to mean the same data in different systems is illustrated in Figure 2 (page 18) showing 34 different expressions that have evolved to identify accounting for weapon systems. Each term has a different code associated with it, with several variations of numbers of characters. After disciplining, the meaning of each of the 34 was included in one of the following:

- Account or Weapon System Code.
- Weapon System Designator (OAC).
- Account Code (Ownership) Weapon.

Use of 34 different terms resulted in unnecessary data conversion, unnecessary ambiguity, and unnecessary related costs.

Data Systems

SYSTEM	A	B	C	D	E	F	G	H	I	J	K	L	M
CONDITION	CODES												
NEW		S	A	I	A	N	N	A	N	S	I	I	I
USED			C			E			E	U			
REPAIRABLE			I	6	E			E			2	2	2

Figure 1.

The basis needed to establish and maintain multiple purpose data files, integration of data systems, and automatic transfer of data between equipment systems is standard data elements. Lack of standardization in data elements creates a communications barrier. One system cannot talk to another system. Data bases cannot talk to each other. Machine systems cannot talk to each other.

Improvement Actions

How can consolidated, integrated, or data-banked information be given meaning? How can industry data banks talk to DOD data banks where needed? Or with other industrial data banks? Or with organizations such as the Internal Revenue Service to send data on taxes?

Steps must be taken to assure that the information means precisely the same thing, expressed in precisely the same way in every potential place where consolidation, integration, remote input, or all, might be feasible. It means establishing a standard word or data element at the lowest possible level of meaning—indivisible. It means establishing an agreed upon definition for that word. It means establishing a standard code by which to express the allowable values relating to that meaning.

Improving intercommunication of data is the purpose of the DOD Standard Data Element and Data Code Program, organized in 1964 and implemented in 1965 under the direction of the Office of the Assistant Secretary of Defense (Comptroller). An extended and complex body of technical knowledge has been developed by DOD to be used in construction of the standard data vocabulary for data systems. A few examples illustrate the general approach:

Example 1:
Data Element: Year
Data Item: 1967
Data Code: 67

Example 2:
Data Element: Continents
Data Item: Africa
Data Code: AA

Example 3:
Data Element: Contract Pricing Provision
Data Item: Cost Plus Fixed Fee
Data Code: U

The data element is the generic class of data. Data items are those specific units of information or values

34 DATA TERMS USED IN VARIOUS DATA SYSTEMS

ACCOUNT OR WEAPONS SYSTEM CODE (3AN)
WEAPON SYSTEM OR ACCOUNT CODE
ACCOUNT OR WEAPONS SYSTEM CODE (2A)
ACCOUNT OR WEAPONS SYSTEM CODE (2N)
ACCOUNT OR W/S (Distribution) CODE
ACCOUNT OR WEAPON SYSTEM
ACCOUNT CODE
WEAPON SYSTEM DESIGNATOR/OAC
WEAPON SYSTEM OR ACCOUNT CODE
WEAPON SYSTEM OR ACCOUNT CODE
WEAPON SYSTEM DESIGNATOR/OAC
WSM DESIGNATOR OR ACCOUNT CODE
SSM/IM
WEAPON OR ACCOUNT CODE
ACCOUNT CODE (Ownership)
MISSILE DESIGN CODE A
ACCOUNT CODE (Basic)
ACCOUNT OR WEAPONS SYSTEM CODE (2AN)
ACCOUNT OR DISTRIBUTION CODE
WEAPON SYSTEM DESIGNATOR (3N)
WEAPON SYSTEM DESIGNATOR "84"
WEAPON SYSTEM DESIGNATOR CODE (2AN)
ACCOUNT CODE (Basic Account)
ACCOUNT NUMBER
ACCOUNT OR DISTRIBUTION CODE
ACCOUNT CODE OR WEAPON SYSTEM CODE
WEAPON SYSTEM (Distribution Code)
ACCOUNT OR WEAPON SYSTEM CODE (Ownership)
WEAPON SYSTEM CODE
WEAPON SYSTEM OR ACCOUNT NUMBER
DEPOT ACCOUNT CODE
DEPOT BASE OWNERSHIP ACCOUNT CODE
WEAPON
WSD

all meaning

WEAPON SYSTEM DESIGNATOR
BASIC ACCOUNT
OWNERSHIP ACCOUNT

Figure 2.

which share the homogeneous characteristic which establishes the class of the data element. The data code is the expression of the data item for use in data processing equipment.

By controlling the use of these standard data elements in DOD data systems and eventually using standard data elements in all DOD data systems, where applicable, the data communication problem will be greatly alleviated and the potential of our automated equipment can be realized.

Figure 3 illustrates the use of a standard data element. The DOD standard data element, "Social Security Identification," in use in a data system may be called a variety of things. This illustration shows its use as driver's license number, a bond account number, stockholder number, employee number, personnel identifier, and bank account number. However, the essential *meaning* of the data element remains unchanged and its expression, *i.e.*, data items, remain unchanged. The same identifying number is always used to identify the same person.

Use of standard data elements in DOD and other data systems can remove the entire communications barrier. Through standard data elements, systems can talk to each other. The right column of Figure 3 illustrates how the input to an individual's income tax record can be integrated from several other data systems into the income tax system.

DOD Standard Data Projects

About 30 projects for data element standardization have been undertaken within DOD. These projects have been assigned to the various military departments and defense agencies for development of standard data elements and related codes. Some of the project assignments for standardization of data elements and codes are:

- Military Standard Contract Administration Procedures (MILSCAP) by the Defense Supply Agency.
- Joint Uniform Military Pay System (JUMPS) by the Air Force.
- Configuration Management Accounting by the Navy.

Hundreds of data elements are being studied in these projects. Many existing codes and data expressions will be eliminated through the refining process of subjecting them to the disciplines of data standardization and developing standard data elements for use in all data systems by all DOD organizations. Application of these disciplines have disclosed that the same data has been included several times in the same data record. For example, identification of a requisitioning organization has been included as the "Ship To" address and redundantly recorded as part of the fiscal code.

The approach to the DOD Standard Data Element and Data Code Program is to standardize the data elements and codes in data systems at the time of their development or major redesign; to standardize as quickly as possible those data elements and codes common to most data systems throughout DOD; and to standardize the remaining data elements and codes in existing operational data systems as time permits. These steps are both sequential and simultaneous, depending on the case. Implementation of the standard data elements is a separate action from the standardization itself. Implementation will be undertaken on a scheduled basis to make the least impact on operational data systems. Implementation of standard data elements will be individually scheduled by system or by data element.

Since 1964, a great deal of progress has taken place. Much of it has a direct bearing on the DOD/industry data interchange.

On Sept. 19, 1968, MIL-STD-482[1] titled, "Configuration Status Accounting Data Elements and Related Features," was issued. It prescribes the standard data elements to be used in all configuration status accounting records, providing DOD and industry with the information needed to identify the initial configuration item and

USE OF A STANDARD DATA ELEMENT

SOCIAL SECURITY ACCOUNT NUMBER (SSAN)

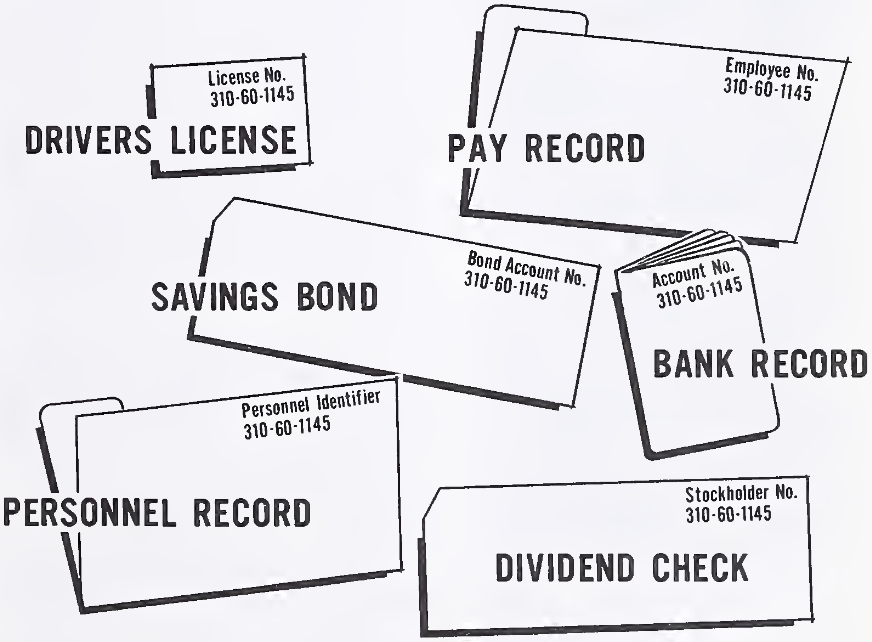

Figure 3.

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[1] *Available from Director, Navy Publications and Printing Service Office, Building 4, Section D, 700 Robbins Avenue, Philadelphia, Pa. 19111.*

determine the status of change proposal and change implementation actions. Sample data elements in MIL-STD-482 are "Action Priority," "Configuration Item Identification," and "Configuration Resource Affected." These standard data elements were coordinated throughout DOD and with many industrial organizations through the Electronic Industries Association, Aerospace Industries Association, and the National Security Industrial Association to incorporate the data requirements of the maximum number of potential users.

The Military Standard Contract Administration Procedures (MILSCAP) project has standardized about 60 data elements for use in data systems relating to contract administration. Many of these standard data elements have already been incorporated into the Armed Services Procurement Regulation (ASPR). Sample data elements standardized under MILSCAP are "Contract Action Office Type," "Contract Item Status," and "Logistics Site."

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In the area of military pay, the data element standardization assignment for the Joint Uniform Military Pay System (JUMPS) has resulted in about 70 standard data elements. Many of these standard data elements will be used in data systems beyond the pay system environment. Banks, insurance companies, unions, charitable fund organizations, etc., at the least, require in their records the standard data element, "Social Security Identification," the individual's social security number. Other sample data elements standardized under JUMPS are "Deduction Type, Pay" and "Familial Relationship."

On March 1, 1970, DOD Manual for Standard Data Elements 5000.12M[2] was published. This manual includes all DOD standard data elements, and their related codes, for use in all DOD data systems. At the time this article is being written, DOD has standardized and published approximately 250 standard data elements and related data codes.

Logistic Data Standardization

After about a year of planning, early in 1971 a major effort was started to standardize data elements for use in DOD logistics data systems. Development of this project, called Logistics Data Element Standardization and Management Procedures (LOGDESMAP), has been assigned to the Office of the Assistant Secretary of Defense (Installations and Logistics). Its major objectives are to:

- Improve management of DOD resources, at every level, through reduction of unnecessary overlap and duplication between and among the DOD logistics systems.
- Provide a common base of standard data elements and codes for use throughout the DOD logistics community, as well as other affected communities.
- Facilitate interface of logistcs data systems and interchange of data between and among such systems.
- Reduce, eliminate, and prevent ambiguities in the present and future logistics data language.
- Reduce the overall cost of data system design, development, programming, and operation throughout all applicable DOD data systems.
- Provide a fundamental building block support for DOD logistics systems planning efforts at each echelon of management.

The data elements standardized through LOGDESMAP, under the DOD data standardization criteria outlined in DOD Manual 5000.12M, will be used in all other DOD data systems where applicable. For example, if a data element such as "Color" or "Unit of Measure" is standardized by LOGDESMAP, it will be used by any other DOD data system needing such data elements, whether the data system is for such a function as personnel, accounting, or any other.

The LOGDESMAP plan includes the establishment of a computerized file of data elements, related features, and selected system application data, *i.e*, what systems, what authority or reference document, what data forms are affected The file will serve as the basis for control over new data element entry into logistics data systems, providing visibility of where newly standardized data elements require implementation, the basis for orderly data element implementation planning, and prevention of entry of non-standard data elements into logistics data systems.

The LOGDESMAP group has been assembled and has started laying out schedules for accomplishment of the projected data element standardization work. The first phase of work, data system requirements simplification, has been undertaken.

Inquiries on the DOD Data Element Standardization Program, its policies, procedures, participation and impact may be directed to the Director for Data Standardization Policy, Office of the Assistant Secretary of Defense (Comptroller), Room 3A 918, The Pentagon, Washington, D.C. 20301, telephone (202) OXford 7–8636.

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[2] *Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Document No. D1.6/2:D26, price $7 (including updating).*

A Central Point for Administration of Maintenance Contracts

Colonel Richard G. Schulz, USAF

In September 1969, the Air Force Logistics Command (AFLC) established the Air Force Contract Maintenance Center, with headquarters at Wright-Patterson AFB, Ohio.

When activated, the center was given responsibility for contract administration at 13 industrial plants located primarily in the southeastern United States. The Defense Department assigned responsibility for contract administration at these plants to AFLC because of the predominance of Air Force contracts resulting from logistics support needs.

Within 10 months, operations had progressed to the point where the center was able to assume responsibility for AFLC's contract maintenance in Europe and the Far East. Shortly thereafter, the Maintenance Center also was assigned contract administration at the Boeing Wichita complex, Wichita, Kan., formerly a responsibility of Air Force Systems Command

Today the Air Force Contract Maintenance Center consists of a small headquarters staff, eight detachments in the continental United States, four detachments in the Far East, and three detachments in Europe.

The center's headquarters staff is aligned into five directorates and one office to deal with the major functional responsibilities normally involved in maintenance contracts:

- Quality Assurance.
- Production.
- Industrial Property.
- Contract Administration.
- Flight Test and Safety.
- Plans and Management Office.

Detachments are organized in a similar manner.

The Maintenance Center's detachment offices are generally located in contractors' facilities. While some contractors have their own private facilities and others use existing military facilities, almost all are located on commercial airports.

The detachments average 30 people, and the commander is normally a major or lieutenant colonel. Most detachments administer contracts involving only one or two contractors; however, this is not always true. One detachment administers contracts with 40 different contractors. In fact, on a day-to-day basis, the 15 detachments and 14 sub-offices deal with over 77 contractors, including 30 foreign contractors and no less than 14 foreign governments.

Among other reasons, the Contract Maintenance Center was established to give the maintenance contractor a focal point in his dealings with the government. All of a contractor's defense contracts, from Army, Navy, Air Force and National Aeronautics and Space Administration, are administered by the detachment located at the plant.

The local detachment commander's position is comparable to that of the contractor's general manager or plant manager. All the government's representatives (administrative contracting officer, property administrator, quality assurance representative, flight test officer, production specialist, etc.) report to the detachment commander. If a problem arises between the contractor's personnel and a government employee, the detachment commander is the government's representative, the government's "one face to industry," and is authorized to settle the matter. He is on the spot, is generally knowledgeable of the peculiarities involved, and is responsible for the outcome.

As the name implies, the Air Force Contract Maintenance Center's primary responsibility involves the administration of maintenance contracts calling for the modification or inspection and repair of aircraft, and overhaul of aircraft engines. These contracts cover about one-fourth of the first-line fighter and cargo aircraft in the Air Force operational inventory.

Contracts range from routine spare parts production contracts to highly complex, multi-year maintenance contracts for inspection and repair of fighter aircraft. Additionally, the center administers communications and electronics contracts calling for construction of huge electronic receiving or transmitting stations, some of which are used in the space program. Recently, the center assumed responsibility for contractor field team con-

Colonel Richard G. Schulz, USAF, is Commander of the Air Force Contract Maintenance Center, Wright-Patterson AFB, Ohio. Prior to assuming this command, Colonel Schulz was Commander of AFLC's Air Procurement Region Far East.

tracts. These contracts generally call for modification of aircraft or repair of battle-damaged aircraft by a team of experts from both the contractor and the government and, as the "field team" name implies, the modification is frequently accomplished at remote sites without benefit of fixed facilities.

Contracts administered by the center are usually complex. They contain multiple pricing and payment provisions, constantly changing work specifications, and continuous negotiations and joint-decision clauses which allow the contractor and the government to negotiate throughout the life of the contract. For instance, a portion of the contractual work may be reasonably known beforehand. Such a contract becomes fixed-price, and is usually based on competition. Another portion of the work may be cost reimbursable. In a contract of this nature, both contractor and government share in the risk of work accomplishment. The government, in essence, realizes the risk of the work and allows the contractor to be reimbursed on costs, but at a lower profit margin. Still a third type of contract may combine the two arrangements just discussed. This multiple pricing structure is necessary due to the imponderables involved in the repair or maintenance of complex aircraft and engines.

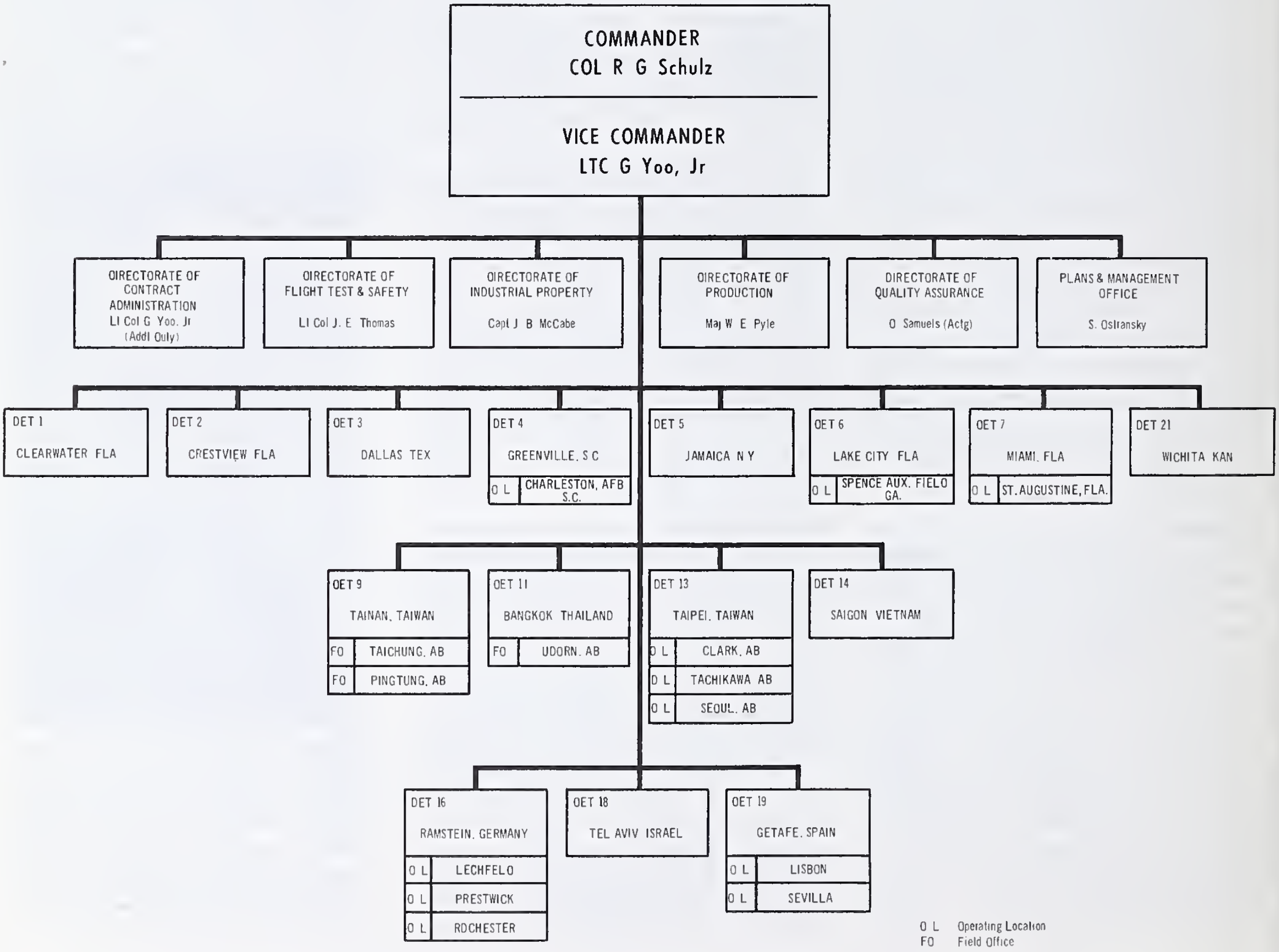
In most instances, the complete scope of the work is not known until the aircraft is completely stripped of its outer skin. Then such things as extent of corrosion, wear and tear, or battle damage can be assessed. At this point, the on-site government representative and contractor personnel must determine what additional work is to be done and at what price. The typical maintenance contract facilitates such negotiations in that an "over and above" rate per hour is included in the contract. The contractor and the government representatives would then agree on the number of hours involved.

If a certain part of the aircraft is beyond repair, the typical maintenance contract may provide that the

(Continued on inside back cover)

AIR FORCE CONTRACT MAINTENANCE CENTER (AFLC)

WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433
Phone: (513) 257-0788



Management of System Acquisition Programs in the Air Force

Major General Lee V. Gossick, USAF

Soon after Secretary of Defense Melvin Laird assumed his position in January 1969, the Office of the Secretary of Defense announced its intent to decentralize system program management responsibility to the military services. Under the new policy, the Services are now responsible for detailed justification of proposed programs and, after approval by the Secretary of Defense, for management of the programs with monitorship of the Office of the Secretary of Defense.

In the past two years, several policy and procedural changes have taken place in the decision and management process of major system acquisition programs. This article gives a capsule view of the major steps in the Air Force management of the acquisition of a system throughout the life cycle of the program, and discusses recent Air Force actions to reduce paper work and streamline the management process in accordance with Deputy Secretary of Defense David Packard's desires.

The Air Force Systems Command is the principal management agent of the Air Force in the marshalling and use of existing scientific and engineering talent to develop and produce the system being acquired within the approved resources and time frame.

AFSC acquisition policy is predicated on centering all responsibility for the management of a system during all phases of development and acquisition in a system program director (SPD). A system program office (SPO) is organized to assist the SPD. The SPO is manned principally by AFSC personnel, but includes representation from the Air Force Logistics Command, the Air Training Command, and the command which will become the operational user of the system under development.

Systems management considers the whole life cycle of a system from its conception until it is no longer in use. In consonance with Secretary Packard's philosophy, the system life cycle has five phases, with each of the first three phases requiring a decision (approval) before the next phase is entered. The conceptual phase is followed by a program decision. The validation phase is followed by a ratification decision. The full-scale development phase is followed by a production decision. If the production decision is rendered, the production and deployment phases follow. A schematic of the new system life cycle is presented in the centerfold.

In the decision process, the Defense Systems Acquisition Review Council (DSARC) plays a vital role in program review prior to consideration of the decision by the Secretary of Defense. The council has responsibility to review major and important weapon system acquisition programs at appropriate milestone points in their life cycle. These reviews are made to permit coordinated evaluation and deliberation among senior DOD managers, and to assure that complete and objective advice is given to the Secretary of Defense upon which to base his decision to proceed to the next step in the system's life cycle.

The DSARC is composed of the

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Director of Defense Research and Engineering and the Assistant Secretaries for Installations and Logistics, Systems Analysis, and Comptroller. The council meets as the need dictates, *e.g.*, a breach or threatened breach of thresholds, or at the request of a military service Secretary to review the readiness of the appropriate program to transition to the next phase at three basic milestones:

- When going from the conceptual to the validation phase.
- When transition to full-scale development is proposed.
- When transition to production for military service deployment is proposed.

In addition to the review and evaluation by the Defense Systems Acquisition Review Council, another management mechanism, which provides a means for comprehensive review of a major program before decision by the Secretary of Defense and his principal advisers, is the Development Concept Paper (DCP). Initiation of a DCP at the appropriate time in the life cycle of an important system is the responsibility of the Director of Defense Research and Engineering.

The contents of a typical DCP are:

- Issues for decision.
- Program purposes.
- Alternative solutions.
- Proposed cost of system.
- Pros and cons.
- Decision-review thresholds.
- Management plan.
- Matter of security classification.
- Condition for revision.
- Decision options or alternatives.

A DCP is signed by the Director of Defense Research and Engineering, the sponsoring military service Secretary, certain Assistant Secretaries of Defense (such as Installation and Logistics, Comptroller, and Systems Analysis), and then is signed by the Secretary of Defense or Deputy Secretary indicating his decision at each life cycle milestone—entering the validation phase, initiating of full-scale development, and initiation of production.

Conceptual Phase

System program bases are established in the conceptual phase. The program decision following this phase determines subsequent system progression. During this phase, the technical, military, and economic bases for an acquisition program are established through comprehensive system studies and experimental hardware development and evaluation. The conceptual phase is highly iterative, with activities overlapping rather than occurring sequentially, and with the following activities usually occurring:

- Identification and definition of conceptual systems.
- Analysis (threat, mission, feasibility, risk, cost, tradeoff).
- Design, experimentation and test (of operational requirements, key components, critical subsystems, and marginal technology).

Given a military requirement, the primary objective of the conceptual phase is to establish the military, economic and technical bases to support a decision to acquire a new major program. A second objective is to examine alternatives and identify a preferred approach. A third objective is to provide a detailed analysis which will support a decision to proceed into the validation phase with a preferred approach.

To satisfy the primary objective, the military, economic, and technical bases must be established from an analysis of military objectives or threat, and stated qualitatively and quantitatively. Financial and performance constraints must be identified.

To meet the third objective, a detailed examination of the preferred approach is accomplished. The analysis must provide the preliminary system/key subsystem performance specifications (the functional baseline); and must establish the demonstrated state of the art for key subsystems, components, and fabrication/production techniques. Areas of high risk are identified. Risk assessment of technical programs is followed by a judgment of the effort likely to be needed to find a practical solution. Also, the credibility of cost and schedule estimates is established and the procurement strategy and management plan are outlined.

The complete analysis of the program concept and the preferred management approach are stated in the Concept Formulation Package/Technical Development Plan (CFP/TDP), prepared during the conceptual phase and forwarded to Headquarters, U.S. Air Force. The CFP/TDP is supported by system studies, evaluation of experimental hardware developments, and all information necessary to substantiate achievement of all aspects of the objectives in the proposed program. Pending at the time this article was written was a revision to Air Force guidance that would establish three principal documents for acquisition management.

Advocacy Package. The documentation prepared during the conceptual phase which is used to obtain program approval is called the Advocacy Package. The content varies with each proposal and is specified by Headquarters, U.S. Air Force. For major programs, it supports a request to the Secretary of Defense to proceed with the validation phase and contains the basic information from which the Development Concept Paper is prepared. On other programs, it supports the project approval.

Acquisition Management Plan. The system program director issues a Acquisition Management Plan to place in context the integrated and time-phased tasks and resource requirements for all participating organizations.

Acquisition Management Directive. The single directive Headquarters, U.S. Air Force, issues to provide guidance in initiating, changing, transitioning, or terminating programs and projects will be called an Acquisition Management Directive. The management charter, force structure, and deployment guidance are normally included in the initial directive. Also in the works is a top level Air Force acquisition management directive—a new Air Force regulation—that will specify the aforementioned direction documents. It will also define objectives; establish the basis for delegation of management authority, *e.g.*, thresholds, constraints; and establish flow of direction and information to the next subordinate level of command.

When the regulation is published, documentation nomenclature may change; however, the essentials of their purpose and impact are expected to remain as described in this article.

Program Decision

The CFP/TDP supports Air Force inputs to the draft Development Concept Paper. When approved, the Secretary of the Air Force signs the draft DCP and forwards it to the Defense Systems Acquisition Review Council as the Air Force request for program decision. The council reviews the DCP and recommends action to the Secretary of Defense. Signing of the DCP by the Secretary of Defense indicates his decision on the program. The DCP, thus, constitutes the staff management position of the concerned Service and the Office of the Secretary of Defense, and is the decision document rendering approval or disapproval by the Secretary of Defense of major development programs.

As discussed previously, the DCP contains the record of primary program information, decision rationale, and the decision-review thresholds. These thresholds are operating limits which, if exceeded or expected to be exceeded, cause program review by the Secretary of Defense. The thresholds cannot be changed without approval of the Secretary of Defense.

At the end of the conceptual phase, depending on the prognosis of approval and program priority, the documentation required to continue into the validation phase is drafted concurrently with the preparation and review of the DCP. This would include the work statement, request for proposal, source selection plan, and other planning and management documents. These draft documents are not a part of the CFP/TDP, but furnish information which may be called for by the Defense Systems Acquisition Review Council, the Secretary of Defense, or other personnel involved in the decision process.

After program decision (approval by the Secretary of Defense), the budget authorization (BA) is released. The BA identifies various amounts of appropriation to the programs covered. Each BA represents a portion of the approved financial plan for a given year.

The program authorization (PA) is also released after the program decision. Headquarters, U.S. Air Force, separately releases PAs for each fiscal year increment of the program. The PA indicates the quantity of each end item approved for procurement and the associated dollar magnitude.

Concurrent with the BA/PA issuances, the Acquisition Management Directive (previously System Management Directive) is prepared and forwarded to the major commands by Headquarters, U.S. Air Force. The Acquisition Management Directive identifies the availability of financial and other resources, provides authority to the implementing command to establish a system program office (SPO), and establishes the roles of participating organizations, if not already defined. Upon receipt of the Acquisition Management Directive, the Air Force Systems Command prepares AFSC Form 56, "AFSC Program Direction," which assigns program responsibilities within AFSC, transmits the Acquisition Management Directive to the AFSC product division commander having cognizance of the system program, amplifying and adding guidance and direction as appropriate. All program direction within AFSC is conveyed by AFSC Form 56, and this document, with attachments, constitutes the system program director's charter for management authority and action.

Validation Phase

In the validation phase, the major program characteristics (technical, cost, and schedule) are refined and validated through study and analysis, hardware development, or prototype testing. Hardware development and evaluation provide a better definition of program characteristics and greater confidence in the ultimate outcome than paper studies. The validation includes commitments that contractors are willing to make, *i.e.*, contracts they will sign, on major program characteristics. The quantity and level of prototype/hardware validation depends on the nature of the program, risks and tradeoffs involved, and suitability of the system definition products. The decision to use more than one contractor for prototype/hardware proofing is based on risks, tradeoffs, availability of competition, and program resources.

The overall objective of the validation phase is to establish firm and realistic performance specifications (allocated baseline) which meet operational requirements, and to determine whether to proceed with full-scale development. The allocated base line is supported by a cost-type proposal for the full-scale development phase or, when minimum technical risks exist, a fixed-price type proposal may be considered. In general, performance specifications are preferred for full-scale development because detailed design specifications severely limit the latitude of design, engender contract changes, and require excessive pre-contract negotiation.

Included in the overall objective of the validation phase are subsidiary objectives to:

- Provide a basis for contract of commitments prior to source selection.
- Establish technical interfaces.
- Define organization and responsibilities.
- Resolve technical risk areas to the extent feasible.
- Verify technical approaches.
- Establish schedules and cost estimates for the full-scale development phase.
- Establish planning schedules and cost estimates for the production phase.

The validation phase is generally conducted as a DOD-financed effort by two or more contractors working in collaboration with the Air Force under the system program director's responsibility. A competitive environment is established and maintained with the competition in terms of concept, design approach, tradeoff solutions, management plans, schedule, and similar factors, as well as overall cost. Competition is maintained until, in the judgment of the system program manager, negotiations for a satisfactory contract for full-scale development have progressed to a point where competition is no longer required. Competitive negotiations are not based exclusively on cost.

The total effort of the validation phase is evaluated in preparation for the ratification decision. The system design should be approaching the optimum combination of system performance with economy (cost effectiveness). Performance desired for each configuration item should be specified in the allocated baseline, and there should be a minimum amount of risk remaining for resolution in the full-scale development phase.

Ratification Decision

A ratification decision must be obtained from the Secretary of Defense before a system program can enter the full-scale development phase. Program documentation is updated reflecting results of the validation phase and forwarded to Headquarters, U.S. Air Force. After documentation review by the Air Force and approval by the Secretary of the Air Force, necessary information is sent to the Defense Systems Acquisition Review Council. The DSARC reviews the program documentation to assure that procurement methods, contract form, management system, etc., match the job to be done, its goals, risks, and uncertainties. The Development Concept Paper is updated to satisfy ratification decision requirements. Signing of the DCP by the Secretary of Defense constitutes ratification decision.

This decision depends upon confirmation of the technical, financial, and schedule factors of the program. Therefore, as a result of the validation phase, the Air Force will make one of the following alternative recommendations:

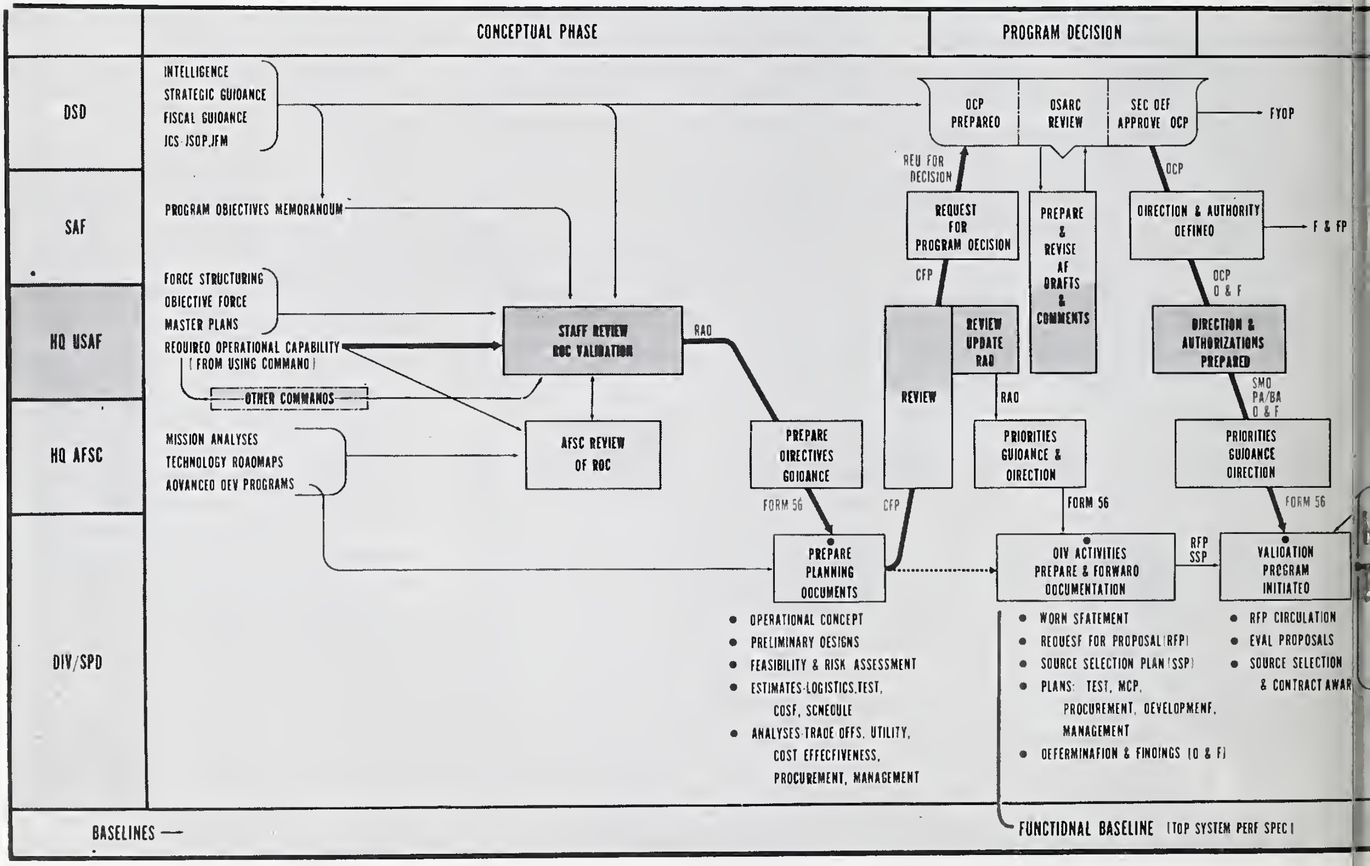
- To contract for full-scale development.
- To continue further validation phase.
- To defer or abandon the development effort.
- To undertake further exploratory or advanced development of key components and/or system studies.

This is a program rather than a source selection decision, although it may include some source aspects such as whether to seek competition or to contract with a sole source. The DCP will identify the next decision, limits on program approval, and thresholds on key program characteristics.

Approval to proceed into the full-scale development phase will be based upon assurance that:

- Appropriate total system tradeoffs have produced a balanced and realistic set of performance parame-

SYSTEM ACQ


CONCEPTUAL PHASE
PROGRAM DECISION
DSD
SAF
HQ USAF
HQ AFSC
DIV/SPD
INTELLIGENCE
STRATEGIC GUIDANCE
FISCAL GUIDANCE
JCS-JSOP,JFM
PROGRAM OBJECTIVES MEMORANDUM
FORCE STRUCTURING
OBJECTIVE FORCE
MASTER PLANS
REQUIRED OPERATIONAL CAPABILITY (FROM USING COMMAND)
OTHER COMMANDS
STAFF REVIEW ROC VALIDATION
AFSC REVIEW OF ROC
MISSION ANALYSES
TECHNOLOGY ROADMAPS
ADVANCED DEV PROGRAMS
RAD
PREPARE DIRECTIVES GUIDANCE
FORM 56
PREPARE PLANNING DOCUMENTS
• OPERATIONAL CONCEPT
• PRELIMINARY DESIGNS
• FEASIBILITY & RISK ASSESSMENT
• ESTIMATES-LOGISTICS,TEST, COST, SCHEDULE
• ANALYSES-TRADE OFFS, UTILITY, COST EFFECTIVENESS, PROCUREMENT, MANAGEMENT
DCP PREPARED
DSARC REVIEW
SEC DEF APPROVE DCP
FYDP
REQ FOR DECISION
REQUEST FOR PROGRAM DECISION
CFP
REVIEW
REVIEW UPDATE RAD
RAD
PREPARE & REVISE AF DRAFTS & COMMENTS
PRIORITIES GUIDANCE & DIRECTION
FORM 56
CFP
DIV ACTIVITIES PREPARE & FORWARD DOCUMENTATION
• WORK STATEMENT
• REQUEST FOR PROPOSAL (RFP)
• SOURCE SELECTION PLAN (SSP)
• PLANS: TEST, MCP, PROCUREMENT, DEVELOPMENT, MANAGEMENT
• DETERMINATION & FINDINGS (D & F)
DCP
DIRECTION & AUTHORITY DEFINED
F & FP
DCP D & F
DIRECTION & AUTHORIZATIONS PREPARED
SMD PA/BA D & F
PRIORITIES GUIDANCE DIRECTION
FORM 56
RFP SSP
VALIDATION PROGRAM INITIATED
• RFP CIRCULATION
• EVAL PROPOSALS
• SOURCE SELECTION & CONTRACT AWAR
BASELINES —
FUNCTIONAL BASELINE (TOP SYSTEM PERF SPEC)

ters.

- High-risk areas have been identified and reduced to acceptable levels.
- Cost/schedule estimates for full-scale development are realistic and acceptable.
- Contractual aspects are sound.

Full-Scale Development Phase

When a ratification decision is given, the third phase of the system life cycle, full-scale development, is begun. The system, including all essential support items, is designed, fabricated, and tested. The intended output is a hardware model and the documentation needed to produce for inventory.

An essential activity of the full-scale development phase is test and evaluation conducted by the contractor and the Air Force. Technical and engineering problems that need to be solved are uncovered in this phase, even though risks have been adequately addressed during the conceptual phase. To overcome problems as they are encountered, tradeoffs will be made within the constraints of stated operational requirements, costs, and operational readiness date.

Overall, the objective of the full-scale development phase is completion of engineering design and solution of major problems. Achievement of this objective must be demonstrated by actual performance testing. Tests are selected, values measured, and criteria for judgment of results clearly delineated.

Before seeking a production decision, the Secretary of the Air Force must certify that:

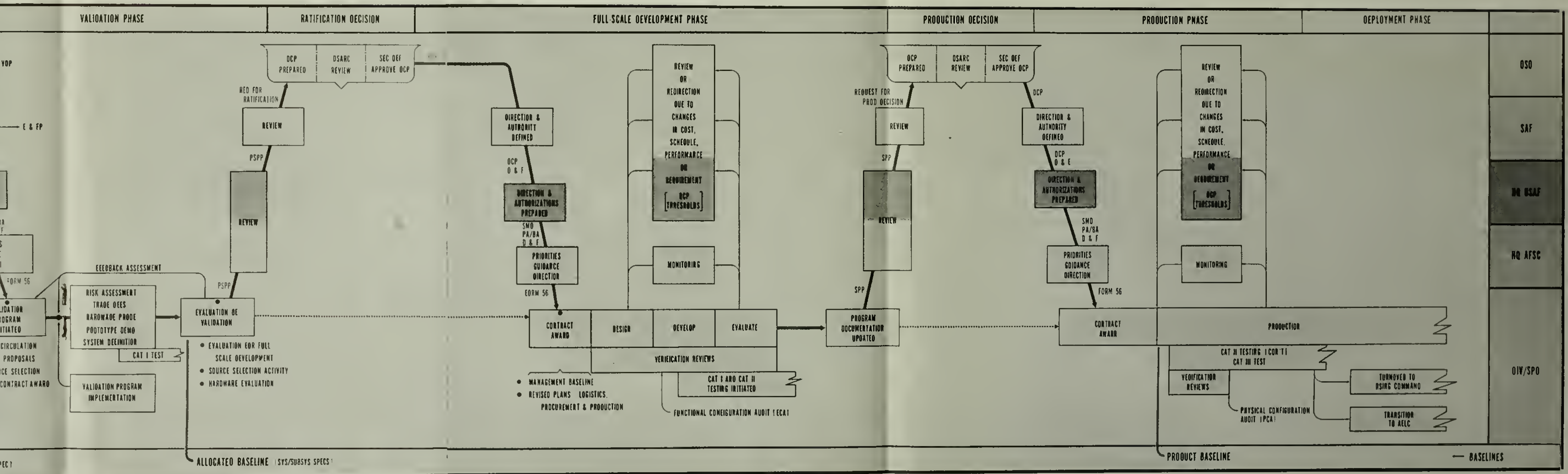
- All milestones which demonstrate achievement of a practical engineering design have been met.
- All important engineering problems encountered during development have been resolved with appropriate tradeoffs with stated operating requirements so that production, maintenance, and operating costs are optimized.

Consideration and planning must be given during this phase to support areas such as maintenance, logistic support, and training. However, deci-

Legend

JCS-JSOP	Joint Chiefs of Staff—Joint Strategic Operations Plan
JFM	Joint Forces Memorandum
RAD	Requirements Action Directive
ROC	Required Operational Capability
Form 56	Air Force Systems Program Direction
CFP	Concept Formulation Plan
TDP	Technical Development Plan
DCP	Development Concept Paper
SMD	System Management Directive
PA/BA	Program Authorization/Budget Authorization
MCP	Military Construction Plan
F & FP	Force and Financial Plan
FYDP	Five Year Defense Program
PSPP	Preliminary System Package Program

ACQUISITION LIFE CYCLE


VALIDATION PHASE
RATIFICATION DECISION
FULL-SCALE DEVELOPMENT PHASE
PRODUCTION DECISION
PRODUCTION PHASE
DEPLOYMENT PHASE
OSD
SAF
HQ USAF
HQ AFSC
DIV/SPO
E & FP
FORM 56
CIRCULATION
PROPOSALS
CONTRACT AWARD
FEEDBACK ASSESSMENT
RISK ASSESSMENT
TRADE OFFS
HARDWARE PROOF
PROTOTYPE DEMO
SYSTEM DEFINITION
CAT I TEST
VALIDATION PROGRAM IMPLEMENTATION
EVALUATION OF VALIDATION
• EVALUATION FOR FULL SCALE DEVELOPMENT
• SOURCE SELECTION ACTIVITY
• HARDWARE EVALUATION
PSPP
REVIEW
PSPP
REVIEW
REQ FOR RATIFICATION
DCP PREPARED
DSARC REVIEW
SEC DEF APPROVE DCP
DIRECTION & AUTHORITY DEFINED
DCP D & F
DIRECTION & AUTHORIZATIONS PREPARED
SMD PA/BA D & F
PRIORITIES GUIDANCE DIRECTION
FORM 56
CONTRACT AWARD
DESIGN
DEVELOP
EVALUATE
VERIFICATION REVIEWS
• MANAGEMENT BASELINE
• REVISED PLANS LOGISTICS, PROCUREMENT & PRODUCTION
CAT I AND CAT II TESTING INITIATED
FUNCTIONAL CONFIGURATION AUDIT (FCA)
REVIEW OR REDIRECTION DUE TO CHANGES IN COST, SCHEDULE, PERFORMANCE OR REQUIREMENT [DCP THRESHOLDS]
MONITORING
PROGRAM DOCUMENTATION UPDATED
SPP
REVIEW
SPP
REVIEW
REQUEST FOR PROD DECISION
DCP PREPARED
DSARC REVIEW
SEC DEF APPROVE DCP
DCP
DIRECTION & AUTHORITY DEFINED
DCP D & F
DIRECTION & AUTHORIZATIONS PREPARED
SMD PA/BA D & F
PRIORITIES GUIDANCE DIRECTION
FORM 56
CONTRACT AWARD
PRODUCTION
REVIEW OR REDIRECTION DUE TO CHANGES IN COST, SCHEDULE, PERFORMANCE OR REQUIREMENT [DCP THRESHOLDS]
MONITORING
CAT II TESTING (CON'T) CAT III TEST
VERIFICATION REVIEWS
PHYSICAL CONFIGURATION AUDIT (PCA)
TURNOVER TO USING COMMAND
TRANSITION TO AFLC
ALLOCATED BASELINE (SYS/SUBSYS SPECS)
PRODUCT BASELINE
— BASELINES

sions in these areas normally will be deferred until the production stage since all such decisions are influenced by the final production design.

Production Decision

Upon completion of the full-scale development phase, program documentation is again updated. Information to substantiate completion of engineering design and system performance capability is forwarded by the Secretary of the Air Force to the Defense Systems Acquisition Review Council. The Development Concept Paper is updated in preparation for the production decision. Approval of the DCP by the Secretary of Defense, after consultation with the DSARC, constitutes production decision.

The production decision determines whether to produce the system for operational use, defines the initial quantity to be produced, and approves plans for future production. A favorable decision depends on demonstration that engineering design for performance is completed, and that sufficient testing has proven performance capability under operational conditions. In addition, soundness of the contractual aspects must be assured, production engineering must be essentially completed, and production capability confirmed to the extent practical.

Production Phase

In the production phase, the system, including training equipment, spares, facilities, etc., is produced for operational use. All decisions deferred from the full-scale development phase to support areas such as maintenance, logistic support, and training must now be rendered by the Air Force in accordance with the requirements and stability of the program. Effective production management systems for control of the factors of production, quality, and finished product inventory are applied.

Tests begun during the full-scale development phase are continued during the production phase. System elements are integrated into a complete system in as near an operational configuration as possible. Contractor participation in testing is not complete until system performance specification requirements are met.

Operational testing and evaluation is conducted on early production items to detect and correct unacceptable deficiencies at the earliest opportunity. The using command prepares plans and procedures, and conducts operational testing. These tests include assessment of system operational capabilities, and evaluation of the logistic system, training, and procedural publications in an operational environment.

Although actual operational testing begins in the production phase, operational test planning is started soon after the beginning of testing associated with the full-scale development phase.

Deployment Phase

The deployment phase begins when production items are provided to and used by operational units. Procedures for turnover to the using command and for transition of the system program to the Air Force Logistics Command are applied.

Turnover is the formal act whereby the using command accepts responsibility for the operation and maintenance of the first operating units of a new system, and assumes property accountability. The using command begins operational tests on the first unit delivered to determine and improve operational capabilities of the system, and to develop the most effective operational tactics, techniques, doctrines and standards. If deficiencies are revealed that are significant to mission performance, system modification may be recommended immediately. Impact on all system elements and their interfaces, including costs and schedules, is evaluated by the system program director in his determination to define and justify modification.

Transition is the formal act of termination of Air Force Systems Command's program management responsibility with its related inherent functions of engineering, procurement and performance of AFSC integrated logistic support tasks. Upon completion of transition, Air Force Logistics Command assumes full logistic support and management responsibility, including related engineering and procurement for the system with the exception of any remaining responsibilities specifically designated as AFSC responsibilities in updated change packages and engineering transfer packages.

Strengthening SPO Operations

The preceding paragraphs have traced the decision and management process of major system acquisitions, highlighting only the major steps, as it exists now under the new perspective provided by Deputy Secretary Defense Packard in his enunciation of acquisition management policy. Not as visible, perhaps, are other improvements to Air Force management which have accrued in keeping with Secretary Packard's emphasis and direction of DOD acquisition efforts.

For example, during the past 18 months there has been a definite strengthening in the authority granted to Air Force system program directors. The Air Force's "Blue Line" reporting system for major programs provides direct access for the system program directors to the Chief of Staff and the Secretary of the Air Force. This significant shortening of lines of communications clarifies and simplifies the delegation of authority. In addition, there are aggressive efforts underway to eliminate many unnecessary regulatory requirements governing system acquisition management and reporting.

System program directors are very much aware of the fact that they are accountable for the success or failure of their programs. Such responsibility has led them to exercise more authority over aspects of the programs bearing on its success or failure. For major programs, the "Blue Line" reporting system is an effective tool for eliminating unessential staff involvement. Problems that cannot be resolved promptly by respective staff levels are brought quickly to the attention of the decision authority. In a related action a "single briefing" policy has been instituted, eliminating numerous, progressive briefings through the staffs of Headquarters, Air Force Systems Command, and Headquarters, U.S. Air Force, required in the past on the way to the decision authority. Based on its success in major programs, "Blue Line" reporting is being extended in AFSC to include many lower priority system programs.

The clearly enunciated policy of granting increased authority to the system program directors has had the effect of reduced staff involvement in program matters. In an associated action, the major Air Force plant representative offices have been reorganized to create divisions designated to support specific system programs. These divisions are directly responsive to system program directors. The performance of the division chiefs will be evaluated by the SPDs.

There are changes in the systems management personnel area, too. In the major system programs, special attention has been given at all levels of command to assure that top quality people are selected for key SPO positions. Manning of these positions is given highest priority and the system program director must personally approve assignments. AFSC has improved tenure by controlling stability of assignment up to the life time of the SPO. Special emphasis has been placed on the larger and more important SPOs by increasing the number of general officers assigned as system program directors.

Contracting Methods

Greater flexibility is now found in Air Force contracting methods. Combination-type contracts are commonplace for weapon system acquisitions where the higher-risk, full-scale development phase and the lesser-risk production phase are combined in a single acquisition, *e.g.*, F–15—Cost Plus Incentive Fee/Fixed Price Incentive Successive Targets (CPIF/FPIS); and the Airborne Warning and Control System (AWACS)—(CPIF/FPIS). The Program Office for Evaluation and Structuring Multiple Inventive Contracts (POESMIC) has been established by the Air Force to provide procurement offices with computer assistance in analyzing, evaluating, and structuring multiple incentive contracts to harmonize with risks to be assumed by government and contractor. (See article, "Experiences in Incentive Contracting," by Captain William K. Jones, USAF, *Defense Industry Bulletin*, September 1970, page 1.)

The use of letter contracts has been drastically curtailed during the past two years, and is now about one-third of the FY 1968 figure. The use of undefinitized change orders has also been reduced, with the end-FY 1970 figures about one-half of FY 1968 figures.

The Cost/Schedule Control Systems Criteria (C/SCSC) enables prudent decisions on tradeoffs and program continuation by providing a vehicle for timely tracking of contractor cost efficiency. (See article, "Contractor Performance Measurement," by Major Robert R. Kemps, USAF, this issue, page 42.) By December 1970, the Air Force had validated C/SCSC implementation with 17 of its major contractors. Additionally, the development and use of the Limitation of Government Obligation clause, which requires a contractor to adhere to the government's annual obligation capability, should reduce the number of late-year reprogramming actions required. Sizable additions of cost analysts has improved Air Force cost analysis capability to the point where it is limited only by the accuracy of defining and predicting programs. The Air Force has also established intermediate and advanced cost analysis courses at Wright-Patterson AFB, Ohio, to assure maximum payoff from the authorized resources. All elements of DOD and NASA use these courses.

Risk Reduction

The Air Force has initiated a program of continuing review and validation of requirements throughout acquisition. "Paper" competition is now the least desired method for weighing alternative designs, while the "fly-before-buy" concept has been incorporated in all new Air Force programs. Examples of programs to which the fly-before-buy concept has been applied are AWACS (competitive radar demonstration), A–X (competitive prototype), and the B–1 (demonstration prototype-feasibility). The Demonstration Milestone clause in contracts for weapon systems will provide the government with a positive assessment of how well the contractor's effort is progressing.

Failure on the contractor's part to perform as scheduled could cause withholding of additional funds and re-evaluation of the risks involved. In the F–15 program, reduction of major program risks have been achieved through tradeoff comparisons and the use of the demonstration milestone concept. System program directors are making increasing use of independent audits and advice by outside technical groups.

Implementation of integrated logistic support (ILS) has been undertaken to improve the logistics considerations of systems acquisition planning. Although ILS provides for early and continuing consideration of the logistic needs of new system acquisitions, detailed logistics planning and decisions are deferred until the program is well defined. ILS is being emphasized by establishment of ILS offices in the SPOs, staffed by the Air Force Logistics Command. For example, in the F–15 program, a senior, full-time deputy director for logistics is collocated in the SPO, and approximately 40 logistics specialists (some located at Warner Robins and San Antonio Air Materiel Areas and at the contractor's facility) work full time on the logistics aspects of the program. ILS has been or is being applied to other Air Force acquisitions in similar fashion.

In summary, the Air Force has listened closely to what Deputy Secretary Packard has had to say in outlining his objectives for systems acquisition management. The Air Force response has been vigorous and positive, but is not yet complete. There is much work to be done in reflecting the actions, summarized here briefly, as formal utterances in the body of regulatory material governing management of systems acquisition. In this area, the Air Force Systems Command is working in collaboration with the Air Staff of Headquarters, U.S. Air Force, in a surge effort to revise Air Force directives, and to assure their compatibility with DOD directives. Possibilities for further improvement, as always, are under consideration. Expected future changes will not be drastic, but will merely represent buffing or fine-tuning of the changes underway or already accomplished.

Mission: Mobility Support

Brigadier General George M. Bush, USA

Mobility is a primary requirement in the Army's fast changing logistics field. The Army Mobility Equipment Command (MECOM) is one of the Army Materiel Command's seven major commodity commands. MECOM has life-cycle responsibility for a broad range of 50,000 items which permit the field soldier to operate with a high degree of mobility.

In its broadest sense, MECOM mobility, as it relates to Army field operations, is concerned with providing capability for movement and for basic living requirements away from a fixed station. It involves items which transport personnel or cargo, such as locomotives and special rail cars, boats and amphibious vehicles; items which may be airlifted such as water purifiers; items which permit movement over land or water obstacles, such as stationary, floating, or portable bridges; items which support vehicle movement, such as petroleum containers and dispensers; and items which clear the way for movement, such as mine detectors; items mounted on wheels, such as field laundries. At the other extreme, MECOM provides items which impede movement of the enemy, such as barbed steel barriers and mine planting equipment. The mobility umbrella covers a broad and diverse range of items.

Army Mobility Equipment Command headquarters is the major tenant at the Federal Center, located at 4300 Goodfellow Boulevard in the northwest section of St. Louis, Mo.

MECOM is organized into five major operating directorates with supporting staff elements. The functions of the directorates cover the operations necessary for the development, procurement, quality assurance, supply and maintenance of assigned items for the Army. MECOM's Directorate of Research, Development and Engineering, known as the Army Mobility Equipment Research and Development Center, is located at Fort Belvoir, Va. The other four directorates are in St. Louis.

Over 3,300 civilian and military personnel are assigned to MECOM headquarters, and about 1,200 personnel are at Fort Belvoir. Additional small field elements include mobility service offices in Vietnam, Germany, Korea, Okinawa, Taiwan, Philippines and Thailand; a marine field office at Norfolk, Va.; and three mobile rail shops.

The payload of the MECOM mission is supplying assigned equipment in these major categories:

- Materiel transportation and handling.
- Troop support.
- Power generating.
- Field support and construction.
- Backup technical support and assistance provided to equipment users.

Total management control is exercised over about 50,000 items, of which approximately 10 percent are major equipment end items. The command also uses about 120,000 other items which are managed by other agencies. For example, hand tools purchased and stocked by the Defense Supply Agency are used by MECOM in Engineer Shop Sets.

Most of the major equipment categories are self-explanatory. The power generating category involves a complete range of portable generators of all sizes and types, fuel cells, commercial and military standard engines —everything required to provide electric power away from permanent posts.

Construction equipment includes the familiar items seen at industrial building sites and road improvement areas such as tractors used as prime movers for scrapers and heavy towed loads, crushing and screening plants, and asphalt plants. It includes commercial items which have been militarized by adding special capabilities for off-road movement and operation in extremes of weather, with emphasis on reliability and maintainability such as a rough terrain crane.

The materiel transportation and handling equipment category includes vehicles used to transport both cargo and personnel, and equipment which handles bulk packaged items. Typical transport items include patrol boats, amphibious lighters; roll-on roll-off lighters, landing craft and beach lighters which discharge cargo and personnel over a ramp to the beach, then move off the beach; mobile assault bridges which function as ferrys or bridges; and locomotive and rail cars. Fork lift trucks, both conventional and those militarized to operate over rough terrain, are used to handle CONEX containers and other heavy, large bulk items.

Troop support equipment is basically related to the survival or comfort of the soldier living in the field. Examples include fresh and saltwater purifiers; power packages providing heating, cooling and cooking facilities for field hospitals; air conditioners and heaters; mine detectors, both hand held and jeep mounted; shower units and portable laundries.

Field support equipment relates to operational requirements such as a 15-gallon-per-minute POL (petroleum oil lubricant) filter used in helicopter refueling, POL storage and distribution systems, and trucks fitted with equipment maintenance tools.

Some of the numerous secondary items supplied by MECOM include compasses, pressure gages, surveying instruments, camouflage netting, life saving equipment, diving gear, printing plants, paint sprayers, and portable field organs for chapel services operated by bellows or battery.

Research, Development and Engineering

The MECOM story logically begins with the Directorate of Research, Development and Engineering, where research and development work is accomplished.

This research is both basic and applied. Basic and exploratory research is the basis for initiation of advanced development effort which, in turn, leads to engineering development. Following completion of engineering development, an equipment item is "type classified" for use by the Army.

When the Army designates a new item of equipment as being type classified, it means that it has passed required tests and has been accepted into the supply system. A complete reference record of the item is established. A federal stock number is assigned to the item within a specific supply class. The item description or nomenclature and such information as initial cost and manufacturer are also recorded. This record is used by the Army as a basis for planning additional procurements, and maintenance and support of the item through its life cycle. The fact that an item has been type classified is usually of interest to qualified manufacturers, since they may be interested in bidding on future contracts.

After type classification, engineering support is provided during the production and operational phases of the item's life cycle.

Engineering support includes monitoring of the contractor's pre-production tests, coordinating production engineering, resolutions of problems occurring with fielded items, and provision of the Technical Data Packages (TDP). The TDP contains the required data to produce, inspect, and package an item for the Army.

The Directorate of Research, Development and Engineering also prepares and publishes technical manuals and repair parts lists required for maintenance and service of MECOM equipment.

This directorate is also responsible for standardization, with a dual goal of fielding standard families of items and making use of standard, interchangeable parts.

Procurement Activity

The Directorate of Procurement and Production acts on procurement work directives prepared by the National Inventory Control Point (NICP) operation in the MECOM Directorate of Materiel Management. These directives are issued after requirements are determined in the NICP and procurement programs have been approved by higher headquarters. The Procurement and Production Directorate assembles procurement packages, issues bid solicitations, and awards contracts covering procurement of locomotives, rail car accessories, all types of construction and maintenance equipment, electrical power generating equipment, and troop support items.

In some instances, Military Interdepartmental Purchase Requests (MIPR) are submitted to designated DOD procuring offices for procurement under the DOD coordinated procurement program. This program is detailed in the Armed Services Procurement Regulation (ASPR) paragraph 5–1106.1. Basically, it provides the mechanics to permit one DOD component (military department or defense agency) to buy an item needed by another component. For example, if the Navy needed mine detectors, the paperwork (request, fund citation) could be sent to the Army. MECOM, as the manager for mine detectors, would buy the detectors for the Navy. No money changes hands, just paper work.

The Directorate of Procurement and Production must analyze the production capability of a potential contractor and monitor the item through its production cycle. The directorate normally works with about 500 manufacturers and awards over 20,000 contracts annually.

Within the directorate, a Small Business Advisory Assistance Office provides assistance, counsel and guidance to small businesses and labor surplus areas.

With the diminishing U.S. commitment in Vietnam, the MECOM procurement program has decreased from a high year of nearly $1 billion dollars in FY 1968 to an estimated procurement of over $200 million in FY 1971.

MECOM's Value Engineering Program operates within the Procurement and Production Directorate. The program focuses attention on the simplification of defense materiel, with consequent general improvements in operational availability and logistic

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support. Since most of the design and manufacture of defense materiel is done by industry, contract provisions permit contractors to share in the savings that result from their recommendations.

Contractor change proposals have done much to reduce acquisition costs of materiel, but of equal importance is the impact of contractor proposals on improving reliability, ease and safety of operation, and reduction of maintenance time and costs.

A recent Value Engineering Change Proposal (VECP) recommended a bronze-fitted pump in place of the all-bronze pump that was specified by the contract. It is estimated that the gross contract savings will be $73,000. In accord with the Value Engineering incentive clause, the contractor will receive $36,500. In another instance, a VECP proposed a less costly engine than that required in the original contract. The government and the contractor shared equally a contract savings of $388 000. In addition, the contractor received $4,400 as his share of a $44,000 collateral savings to the government.

Over 70 contractors have participated in the MECOM Value Engineering Program, and have had over 100 of their proposals accepted. A total savings of around $6 million has been shared with contractors. One contractor received approximately $500,000 for two accepted proposals, and another contractor was paid over $100,000 in royalty payments for his share of the savings in future acquisition costs.

Product Assurance

The Product Assurance Directorate plans, develops and manages the life-cycle program for reliability, maintainability, quality, and system performance assessment of MECOM systems and material.

A life-cycle program of reliability/maintainability engineering is conducted to ensure the incorporation of appropriate system performance parameters, such as reliability, availability, and maintainability, into material needs documents, contract requests for proposals, or invitations for bids and technical data packages. Contractor reliability/maintainability programs are monitored and technically controlled through procurement contracting officers.

The life-cycle quality engineering program encompasses the management and control of inspection engineering requirements or quality assurance provisions in contract specifications and technical data packages for building and rebuilding of material. It also includes management and control of design and development of acceptance inspection equipment and special acceptance inspection equipment.

A program of independent assessment is conducted to provide the status of MECOM material at in-process reviews and command reviews. The assessment may take the form of a system performance assessment, system effectiveness assessment, or technical performance measurement, depending upon the system or material being developed. As an example, performance parameters assessed may include reliability, availability, maintainability; durability; system safety performance. Speed, weight, or other appropriate significant performance parameters may be assessed when Army system engineering design processes are employed.

The system performance assessment program, in addition to the previously discussed assessments for in-process reviews and command reviews, provides regularly scheduled written status reports on material of command interest. This is a management report which forms the basis for command decisions.

A program of reliability improvement of selected equipment is conducted to identify command material or systems where improvement of performance parameters, primarily reliability, provides a cost payoff in reduction of operating and maintenance costs. This program directs its primary attention to operational material.

The Armed Services Procurement Regulation and military specifications provide the basis for the quality operations program. MECOM policy is based on Section 14 of the ASPR. The contractor's quality control system is established in accord with MIL–Q–9858 (Quality Program Requirements), MIL–I–45208 (Inspection System Requirements), or the Standard Inspection Clause (Standard 32).

During the production phase, the contractual documents, specifications, and drawings establish the criteria and standards which are imposed on contractors. Checklists are developed and used by government quality assurance personnel during inspection for compliance. MECOM quality assurance specialists visit contractor facilities to determine the need for special instructions as part of the quality surveillance program.

Visits are also made to contractor facilities to witness tests and testing facilities to be used and to check testing schedules and requirements. Follow-up production and detection visits are made as required to assist in resolving quality problems. All visits to contractor facilities by Army representatives are coordinated with the government activity having plant cognizance or contract administration responsibility.

The Product Assurance Directorate is the focal point for all tests of equipment conducted for MECOM by the Test and Evaluation Command (TECOM).

The initial production testing of new equipment involves a split responsibility. MECOM determines its testing needs and gives TECOM a projected five-year test program. MECOM budgets for the test and provides test items and technical support, including arrangement for contractor technical representatives, support equipment and repair parts. TECOM plans the test and prepares the test plan. TECOM conducts the test and reports test results, which state whether the item is suitable or unsuitable for issue.

Headquarters, Army Materiel Command, determines which items require release authority prior to issuing them to the user commands. After these items are identified, MECOM determines which items are to be tested by TECOM. TECOM then prepares a plan of test for each item, using the contractual specification(s), and any user's requirements not identified in the specification. The TECOM test determines the system's compliance with performance parameters, such as reliability and maintainability, specified in the user's mission need. Where feasible, the contractor's acceptance testing is witnessed by TECOM representatives to prevent duplication of testing.

The contractor's preproduction test results may also be used by TECOM to prevent duplication of tests. The contractor is responsible for furnishing technical assistance and, in some cases, repair part support during TECOM testing. The contractor must correct deficiencies observed during TECOM testing that are determined to be his responsibility.

Materiel Management

The Directorate of Materiel Management provides procurement direction based on determinations of requirements. It operates in accordance with the Army Materiel Command's standard commodity command concept.

In FY 1971, the monthly receipt of orders averaged 15,000. This volume was as high as 60,000 monthly in the early Southeast Asia buildup.

Processing of orders is handled primarily by automatic data processing. MECOM uses two IBM 360/50 computers with disk storage, one IBM 7010 tape processing computer, two 360/30s, an optical character reader, and equipment capable of storing processed data on microfilm.

Worldwide Maintenance Operations

The Directorate of Maintenance is the MECOM control point for global maintenance functions and technical assistance provided to users of MECOM equipment in all military services.

Maintenance functions are primarily concerned with the introduction of new equipment, initial provisioning (determination of repair parts, tools and other support required), and reprovisioning. Technical assistance to user commands is provided after the equipment is fielded. Changes are made to equipment as required to ensure effectiveness and economical maintenance through the life cycle.

It is the policy of the Department of the Army that trained and qualified personnel will be available to operate and maintain new or modified equipment prior to introduction of the equipment to field commands. The Army's definition of New Equipment Training (NET) is all training for the initial transfer of knowledge from the Army materiel developer to personnel performing engineer and service tests, key instructor, key depot, and other personnel as required.

To accomplish this important task, New Equipment Training personnel assigned to the Army Mobility Equipment Command maintain close liaison with the manufacturers producing MECOM's equipment for the Armed Forces. Prior to manufacturers' production runs of the equipment, the New Equipment Training personnel determine requirements for training by the manufacturers' representatives either at the manufacturers' training facilities or at government facilities in the United States or overseas.

Courses of New Equipment Training conducted at manufacturers' training facilities usually consist of two or more classes for key personnel. The number of classes and students depend upon the quantity and complexity of the equipment being procured. Students are, generally, already qualified on similar items of equipment. The training primarily addresses the differences between new equipment and existing or similar items of equipment. Upon completion of training conducted by the manufacturers' instructors, the students return to their respective commands to assist in training other personnel or to perform their various tasks.

MECOM's maintenance responsibility for Army ships is accomplished through contracts with industry. The command's Marine Field Office, which is located in the Naval Annex Building 625, Norfolk, Va., provides for maintenance or dry dock services. Industrial contracts are awarded through formal advertising. Announcements are published in the *Commerce Business Daily*. The Marine Field Office also performs preaward surveys of contractor facilities.

The vessels in the "MECOM fleet" are primarily non-ocean going, ranging in size from 35 feet to 143 feet. However, there are 16 larger ocean-going freighters in the fleet. These freighters are equipped with gear for loading and unloading, and are capable of moving to overseas destinations under their own power.

The marine and amphibious vessels are used to transport cargo and personnel from ship to shore, shore to shore, and on inland waterways supported by barges. They are also used in support of terminal operations within a port or beach complex, providing fire protection with fire equipment on tugs. They include harbor tugs, floating cranes, landing craft, and amphibious vehicles. Some boats are used for patrol purposes. The Army Reserve and National Guard receive training with a variety of these Army vessels.

Equipment Maintenance in Vietnam

The experience and lessons learned in maintaining equipment in Southeast Asia could be categorized as primarily stemming from high temperature, humidity, and abrasive dust. Some general conclusions are that several basic precautions are needed to minimize wear and breakdown. Special attention must be given to assure adequate ventilation for machinery. Corrosion resisting materials should be used whenever feasible, and some components should be treated to prevent fungus growth.

Construction equipment returned from Southeast Asia has disclosed many problem areas. One of these areas is the interior condition of fuel tanks and hydraulic reservoirs. Heavy rust and corrosion are present in 90 percent of the fuel tanks and hydraulic reservoirs. The extreme operating and environmental conditions encountered in Southeast Asia are no doubt the contributing factors.

Expensive repairs and equipment deadline rates resulting from contaminated fuel and hydraulic systems could be greatly reduced by attacking the problem at the source. Industry and government should consider the use of new and different materials at time of manufacture along with a method of impregnating or coating the interiors to prevent rust and corrosion.

Normal cooling systems for construction equipment have proven inadequate. The fan picks up vegetation which clogs the air passage. This reduces cooling capacity and causes overheating of equipment.

High temperature and humidity also result in failure of rubber products, such as motor mounts. Life expectancy is measured in months rather than years. Critical insulating material cracks and crumbles and must be replaced with a fungus-free, nonorganic material.

Following are some observations of MECOM technicians concerning the lessons learned from operating and maintaining equipment in this tropical climate:

- Every effort must be made to simplify the operation, service and repair of equipment. Lubrication fittings must be easily accessible, and the lubricant must be a standard materiel.
- Induction of abrasive dust has resulted in a high engine mortality rate. This problem could be largely eliminated through development of a more efficient air induction system, and standardization of air filters and air filter material which would enable adoption of uniform procedures for cleaning and replacement.

Some specific factors having an adverse impact on equipment dependability in any climate are:

- Location of components. Air cleaners, oil, fuel, and air filters located in a restricted access area are a contributing factor to little or no maintenance. *Lesson learned:* Equipment operators will only service items that can be reached without much difficulty. Also, if tools are required to perform the services, servicing may be neglected due to lack of adequate supervision.
- Corrective maintenance. Check points for testing hydraulic pressure for torque converters, transmission, and other hydraulic systems are not clearly identified. *Lesson learned:* Use of components is excessive due to lack of diagnostic testing.
- Crane booms. Crane booms are often damaged through breakage of wire ropes. *Lesson learned:* Provide wire rope inspection criteria.
- Exhaust system. A rough terrain forklift, equipped with horizontal exhaust, tailpipe facing downward, creates a dusty condition around the machine when the equipment is traveling in reverse. *Lesson learned:* Since engine life is shortened by this dusty condition, the tailpipe direction is changed.

Operations in Vietnam have seen a tremendous increase in the use of mobile electric power. This has spotlighted an Army need for an isochronous governor for "precise power" engine generator sets that will not result in a total power blackout if one of the complicated electronic governor components develops a fault. The improvement needed is the addition of a simple back-up flyweight type engine speed control, which would allow continued use of the generator for utility power needs such as lights, air conditioning, etc., until the necessary trouble shooting and repair of the electronic devices could be accomplished.

Special Items Management

In addition to MECOM's operational elements of procurement, supply, and maintenance, another management element, the Special Items Management Office (SIMO) provides a coordinating and expediting service to put management emphasis on selected items. Typical examples of items managed by SIMO are the power units for the self-contained, transportable medical unit (field hospital), the mobile assault bridge, and the family of military engineer construction equipment (FAMECE).

SIMO operates primarily within the command. However, its representatives occasionally deal directly with industry personnel on an exception basis concerning management problems, as opposed to contract problems, delivery schedules, or quality considerations.

While the command is functionally organized, there is also horizontal coordination on a commodity basis below the directorate level. An item manager for construction equipment in material readiness, for example, deals with the contracting officer responsible for procurement in this category. The product assurance specialist deals similarly with the maintenance equipment specialist for construction items.

MECOM is organized in a mode of decentralized operations, with centralized planning, direction and control. The keystone of this management feedback loop is timely and accurate data with which to forecast trends, establish achievable goals, and identify potential problem areas.

While MECOM is presently applying sophisticated management techniques to its logistics and maintenance mission, the reduction of the Army budget and the consequent requirement for military agencies to do more with less will be an added prime consideration in the command's future operations. In carrying out actions initiated under the AMC's Program for Refinement of the Materiel Acquisition Process (PROMAP)* and with fewer dollars available, MECOM is concentrating on doing a better job in cost estimating. Contracts will be monitored more closely to see that delivery terms and conditions are met.

MECOM considers its relationship with industry as a team effort. The continued success of the command in meeting its obligations to the Field Army depends on the closest cooperation with industry. The contribution of industry to the military logistics program not only provides material for support of the existing mission, but also provides a production base for future needs and a development base for advancing the state of the art.

The requirements of the military have time and again challenged industry to meet a special need. Future improvements in the broad range of items managed by MECOM, many of which have non-military applications, will assure continued mobility for the Army and, in many cases, result in beneficial civilian usage.

MECOM exists to serve the soldier in the field. Its primary function is to provide the soldier with the necessary equipment and service so that he can perform his mission in the quickest, safest, and most efficient way possible. The support of industry is vitally important to the success of the Army's mobility mission.

**See articles, "Program for Refinement of Materiel Acquisition Process (PROMAP–70)," by Major General Paul A. Feyereisen, USA; and "Cost Estimating Techniques for Systems Acquisition," by Major Paul R. Herholz, Defense Industry Bulletin, August 1970, page 18, and December 1970, page 16, respectively.*

Editor's Note: Organization charts appearing in the Bulletin are edited by the staff to reflect those elements which are of interest to industry representatives. Organizations not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone extension numbers is as current as is possible to obtain at the time we go to press.

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ST. LOUIS, MO. 63120

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COMMANDING GENERAL

BG G M Bush	2201-02

DEPUTY COMMANDER

COL F L Worthington	2206-07

SPECIAL ASSISTANTS

CHIEF ENGINEER	L L Gober	2572
EQUAL EMPL OPTY OFF	R Cole	3859
ACFT GND FIRE SUPRSN RESQ SYS	Wright Patterson AFB OH 45433 N Arnold	(513) 255-5542

SPECIAL ITEMS MANAGEMENT OFFICE

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Supply Mgt Rep	E V Compass	3013

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Ft Belvoir, Va , 22060 (703) 664-

Director, CO USAMERDC	COL B L Lewis	5251
Deputy Director	W B Taylor	5251

DIRECTORATE OF PROCUREMENT AND PRODUCTION

Director	COL P A Pencola	3211-12
Deputy Director	A A Scarpa	3202-03
VALUE ENGINEERING OFFICE	P Golden	2661-62
COST & ECONOMIC INFORMATION DIV	W Koshak	3217-20
POLICY & COMPLIANCE DIVISION	A McGrath	3101-02
PRODUCTION DIV		3366-67
PROCUREMENT DIV	D D Pearl	3221-22

DIRECTORATE OF PRODUCT ASSURANCE

Director	R C Cook	2284
PLANS & PROG DIV	O B Keenan	3487
QUALITY OPNS DIV	F A Hill	2294
RELIABILITY/MAINTAINABILITY DIV		2376
SYS PERFORMANCE ASSESSMENT DIV	M A Rumford	2036

DIRECTORATE OF MATERIEL MANAGEMENT

Director (Acting)	F T Belcher	2901-02
POLICIES, PLANS & PROGS DIV	C W Brown	2903-04
DISTR & TRANSP DIV	MAJ L J Landry	2775-76
CATALOG DIV	R J Erxleben	2700-71
INTERNATIONAL LOGISTICS DIV	K B Evans	2807-08
MATERIEL SYS DIV	G Alford	3180-81
PACKAGING DIV	L Hodapp	2707-08
SUP COORD OFFICE	W Lindley	2913-14

DIRECTORATE OF MAINTENANCE

Director	COL T A Murphy	2423-24
Deputy Director	S Fram	2404-24

DIRECTORATE OF PERSONNEL TRAINING AND FORCE DEVELOPMENT

Director	LTC J Massaro	2151-52

DIRECTORATE OF PLANS AND ANALYSIS

Director	LTC L J White	2077-78

COMPTROLLER

Director	LTC M J Dooley	2001-03
Deputy Director	C M Tucker	2001-03

DIRECTORATE OF MANAGEMENT INFORMATION SYSTEMS

Director	J A Saum	3371

LEGAL OFFICE

Ch Counsel	W L Pemberton, Jr	2277-78

SMALL BUSINESS ADVISORY INDUSTRIAL ASSISTANCE OFFICE

Chief	H E Clark	2222

PUBLIC AFFAIRS OFFICE

Chief	J H Packard	2268-69

SECURITY OFFICE

Chief	K G Marcher	2263-64

Mission: Developing Mobility Support

Colonel Bennett L. Lewis, USA

The Mobility Equipment Research and Development Center (MERDC) at Fort Belvoir, Va., is a vital element of the Army Mobility Equipment Command (MECOM).

In addition to its role as an active laboratory complex, MERDC also serves as the Directorate of Research, Development and Engineering for MECOM. The center performs research, development and evaluation (RD&E) necessary for the procurement and support of the major mobility items managed by the command in its five assigned commodity groups—materiel transportation and handling, troop support, power generating, field support, and construction—and provides technical support and assistance to equipment users.

The diversity of these commodities is reflected in the diversity of the center's research and development fields, which include electric power generation, small industrial engines, fuels handling equipment, barriers, detectors and sensors, materials and cargo handling, bridges and structures, mine detection and neutralization, marine craft, construction equipment, camouflage and deception, water supply, environmental control, and materials research.

The center is staffed by more than 1,200 civilians, including approximately 500 engineers and scientists, and 50 military personnel. It is organized into four commodity-oriented departments (electrotechnology, counter-mine/counter-intrusion, mechanical technology, and military technology), plus required staff and several support offices. The MERDC support staff includes a comptroller and a research and development procurement office.

Industry plays a large role in the accomplishment of the center's mission. In FY 1970, contracts awarded to industry totalled over half of the center's budget, and were for research and developmental engineering of equipment, for adaptation of commercial equipment to military requirements, for development of techniques and applications, and for engineering for quantity production. RD&E procurement for FY 1971 is estimated at $33 million.

To participate in center programs, commercial firms, educational institutions, or non-profit organizations request a "Bidders Mailing List Application, SF 129" from the Research and Development Procurement Office, U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. 22060. This application, when completed and returned, is evaluated by technical personnel of the center. Firms and organizations considered qualified to support MERDC programs are then placed on appropriate lists of suppliers. Small business firms receive special assistance.

In its procurement, the center generally employs negotiation, rather than formal advertising since RD&E effort, by definition, precludes detailed design specifications of the items or services to be procured. Contractors are selected on the basis of technical competence, experience, adequacy of facilities, skill, and availability of personnel, quality of workmanship, and plant organization, as well as price.

Proposals responding to MERDC requirements are subjected to a thorough examination and analysis. Material and labor costs are studied, engineering hours are evaluated, overhead rates (factor, overhead, drafting, general and administrative) are com-

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pared with existing data, and subcontracting costs are considered, together with such cost items as special tooling, consultants, and travel. Extreme care is taken to assure that the successful contractor thoroughly understands the scope of the contemplated project, and that he is qualified in every respect to perform.

Industry's efforts in developing equipment for commercial markets are often applied to the Army's mobility equipment needs. Only when an item that has not been developed by industry is required by the troops, does the center conduct its own research. Whatever the source of the item, however, the center must assure, by production engineering and management of technical data, that quality items can be procured in the quantities required.

Industry figures largely in the center's standardization program for mobility equipment which has as its goal holding to a minimum the number of makes, models, and repair parts needed in the Mobility Equipment Command's inventory, thus avoiding a proliferation of items which would strangle the logistic system. Under the program, specifications and standards prepared by the center are coordinated as applicable with a cross-section of industry, the ultimate user.

An important source of information for identifying MERDC, as well as other Federal procurement actions, is the *Commerce Business Daily*, available by subscription at $25 per year via regular mail and $55.25 via airmail from the Superintendent of Documents, Commerce Business Daily, Government Printing Office, Washington, D.C. 20402. The center's "Requests for Quotations," "Requests for Proposals," and "Invitations to Bid," publicized in the *Commerce Business Daily* are furnished by the MERDC Research and Development Procurement Office, upon request, to qualified, legitimately interested prospective bidders/offerors.

The challenge and diversity of the center's mission gives rise to many unsolicited proposals, and an average of 300 are received annually. Those who feel they have contributions to make in mobility support equipment or concepts and who can clearly define their proposed effort and its relevance to MERDC's mission should contact the MERDC Technical Programs Office. This office will arrange for meetings with knowledgeable technical personnel at the center or, if a more formal involvement is desired, arrange registration in the Army Qualitative Requirements Information (QRI) program. The latter puts the research or development proposal in the data bank used by all Army installations, including MERDC.

Close liaison is also maintained with industry through participation in Army-industry briefings, and in meetings and working committees of scientific and engineering societies. In particular, the Mobility Equipment Command Scientific Advisory Group (MECOMSAG) serves to keep the center abreast of technological advances in both industrial and university research. Current members are Chairman G. Edwin Burks, retired vice-president for research and development, Caterpillar Tractor Co.; Dr. L. M. Goldsmith, consulting engineer, formerly with Atlantic Refining Co.; Dr. James J. Renier, vice-president and general manager, Data Systems Division, Honeywell, Inc.; Eugene B. Zwick, consulting engineer in power and propulsion; and Fred Muller Jr., consultant in transportation and physical distribution.

The number and content of the center's programs make complete coverage here impossible. The following representative items, however, may give industry a more specific feel for the research, development, or engineering in which it might participate under contract to the center.

Counter-Mine/Counter Intrusion

Long associated with countermine research and development, the center was designated as the Army's lead laboratory in this area. In support of the Defense Communications Planning Group's sensor program, the center has developed a wide variety of sensors and detectors to find the hit, run, and hide enemy in Vietnam. The center has also developed detectors to locate the enemy's mines, booby traps and weapon caches. The center is now applying these developments and lessons learned to its support of the Surveillance, Target Acquisition, Night Operation (STANO) structure and the associated test and evaluation program under Project MASSTER (Mobile Army Sensor System Test Evaluation and Review).

Already a better detection capability is being provided by an improved non-metallic mine detector, the AN/PRS-7. Solid state components and printed circuitry have both reduced its weight and increased its effectiveness, reliability, and maintainability, as compared with its predecessor. Its design replaces a heavy vacuum tube of complicated electronics, formerly carried on the soldier's back, with a solid state module that can be plugged quickly into a small box on the handle of the detector.

An experimental detector intended to detect surface mines and booby traps is called METRA. A radiating electromagnetic metal detecting system, it can be developed in man-portable, ship- or truck-mounted, and airborne versions.

In mine neutralization, a tank-mounted, mine-clearing roller has

INTRUDER DETECTOR, developed by MERDC, reports hit, run and hide enemy to remote monitor.

been delivered to Southeast Asia, while research is underway on other approaches. For example, tests are being conducted on the application of explosive munitions to actuate land mines.

Closely allied with the MERDC countermine efforts is its counter intrusion program to provide a wide variety of sensors to find a hit, run, and hide enemy. A multi-purpose concealed intrusion detector (MCID) was the first of many seismic, infrared, magnetic induction and balanced pressure sensors developed. Without alerting the intruder, this device detects an intrusion by means of a buried wire, and reports the alarm to a remote monitor.

An improved sensing device, the MINISID is one of several intrusion detectors to monitor enemy movements and enable friendly troops to maintain security with fewer personnel assigned to the task.

Sensors also play a key role in a controllable barrier concept now under investigation. This concept envisions the launching and guidance of explosive mines from buried emplacements to enemy targets, which will be spotted and identified by sensing devices. The center's effort in this area to date has concentrated on acoustic homing as a guidance system.

As a shorter-term goal in barriers, the center is trying to improve the present capability for emplacing conventional minefields. A highly mobile dispenser under development is capable of distributing up to 400 anti-tank mines per hour.

Electric Power

Another major effort is being devoted toward developing equipment to meet growing demands for electric power more reliably and with less logistical effort.

Military electric power is essential to a wide range of communications equipment assemblages, radar, artillery fire direction control, missile systems, computers, battlefield, work area and perimeter lighting, battery charging, and hospitals.

Operational power requirements have increased from about 500 watts per soldier in World War II to approximately 2,000 watts because of more complex weapon systems and changes in military tactics. Increased use of close support air strikes, for example, requires greatly increased communications power. Wider use of surveillance and target location systems in closer support of troops also increases the demand for electric power generation equipment.

Present day requirements are being met with families of generator sets using spark ignition (gasoline) and compression ignition (diesel) engines, and turbines. Reliability problems with smaller sets in Southeast Asia prompted a recently completed major "get well" program aimed at doubling time-between-overhauls from 1,500 to 3,000 hours. These problems stemmed from a number of causes, including high temperatures, excessive dust, failures of auxiliary components, such as ignition systems, voltage regulators, fuel pumps, etc., shortage of trained operators and mechanics, parts supply problems, and improper maintenance.

Direct-coupled turbo-alternators producing up to 200 kilowatts of precise power are being developed to realize potentially lower life-cycle costs, and—more important to the man in the field—greatly increase the reliability and reduce the weight and maintenance effort associated with current equipment. A 10-kw unit, with a design weight of 245 pounds and a design life of 25,000 hours with 6,000 hours time before overhaul (TBO), represents the first practical coupling of a high-speed (93,500 rpm) turbine and alternator on a common shaft in a military field power source. Operating primarily on jet and low-cost diesel fuels, the turbo-alternator also can use combat and aviation gasolines in emergencies. It will weigh some 600 pounds less than the standard 10-kw gasoline engine-driven set and provide 60 or 400 H_z power from solid-state power conditioning subsystems. The smallest and first of a family of turbo-alternators, this advanced power source has many potential applications. It is expected to be used initially where maximum advantage can be obtained from its light weight, *i.e.*, where high mobility is required. The Solar Division, International Harvester Co., is fabricating and conducting extensive engineer development tests on 22 models under a $4.5 million contract.

The fuel cell, because of its high efficiency, simplicity, reliability, quietness, and versatility, is a prime candidate for an important role in the Army's electric power picture.

The major MERDC fuel cell effort currently is on an open cycle, hydrogen-air system deriving hydrogen from the regenerative thermal cracking of available hydro-carbon fuels such as combat gasoline, diesel fuel, or JP4. After approximately 18 months of exploratory development, parallel contracts were awarded for competitive development of a first phase advanced development model 1.5-kw fuel cell plant employing this principle.

Advanced studies are also underway as an early step in a long-term program to develop effective electric drive machinery. Greatly increased versatility and life-cycle cost benefit are anticipated from the use of an electrically propelled vehicle, particularly items of construction machinery. For example, the present Army 20-ton rough terrain crane utilizes two separate engines, one for propulsion and one for craning power. Electric drive would replace the two with one turbine-generator, perhaps hybrided with batteries or fuel cell. Electric wheel motors would provide propulsion power, and electric crane motors would provide craning power. Reduced maintenance, more precise control of functions, and lower overall costs are potential benefits.

Movement of Supplies and Fuel

Certain projects at MERDC directly support new strategic assumptions which emphasize materiel support to our allies in the Pacific; rapid deployment capability for our strategic reserve; and a forward deployment of tank heavy forces in Europe. These projects include beach discharge lighters capable of supporting logistic over-the-shore operations in areas without elaborate port facilities; materials handling equipment and standard containers to speed the shipment and offloading of supplies from aircraft, ships, or vehicles; and elements of fuel handling systems to support the heavy and special consumption requirements of airmobile, armored, and mechanized units.

Efforts are now underway to provide containers of increased capacity and versatility. The new TRICON design has a payload capacity of 13,000 pounds, 4,000 more than the now outmoded CONEX. Built-in coupling devices permit three containers to be joined into an 8-by-8-by-20-foot unit which meets international standards for shipment by rail, road, and water. The TRICON is capable of being handled by materials handling equipment in established ports and terminals worldwide. To handle it, *i.e.*, to load, unload, stack, and transport it, at unimproved terminals or in over-the-beach operations, two different types of commercial machines are being evaluated. One is a front-loading type with a rough terrain capability. The other machine is side-loading and for use on prepared surfaces. Each machine has a lifting capacity of 50,000 pounds (nominal), travelling speed of 20 miles per hour, and a capability of stacking containers three-high.

Many other items of materials handling equipment and containerization are under consideration as part of a long-range program to provide a completely integrated system for moving materiel of any type quickly and economically from the vendor to the user in the field.

In fuels handling, a wide range of equipment, including tanker mooring systems, pumps, pipeline construction and maintenance equipment, storage tanks, decontamination equipment, and dispensing systems, is being developed.

For decontamination, a family of filter/separators has been removing water and solids, such as rust, from fuel to the required levels of 5 parts per million for water, and .5 milligrams per litre for solids. New fuel additives and surfactants, however, are making it difficult to cause water coalescence as required in filtration/separation. New fuels decontamination methods, therefore, such as electro-kinetics, high-energy, resonance, and physico-chemical processes, are under investigation to develop more dependable and economical means of providing clean, high-quality fuel to U.S. Armed Forces throughout the world. In the laboratory, the electro-kinetic method has removed water to less than two parts per million in diesel fuel.

The center is also investigating the use of non-Newtonian additives as a means of significantly reducing friction losses in pipelines and, thereby, reducing the amount, size, complexity, and cost of equipment required to deliver the quantities of fuel required by a modern mobile Army.

Bridges

In the bridging field as in others at the center, high priority was given developments of an expedient nature to meet Southeast Asia demands. For example, the Marginal Terrain Assault Bridge mounted on the M113 Armored Personnel Carrier was developed to provide quick means of crossing irrigation canals in Vietnam that are obstacles to movement, especially in the Mekong Delta. This bridge was developed and fielded in limited quantities in 1969.

A military bridge with a more general geographic and tactical application, and now in the engineering design phase of development, is the Ribbon Bridge. This bridge, its name derived from its design, is a tactical floating bridge which can be employed rapidly with few troops. When the 22-foot bays of the bridge are assembled, they form a continuous cellular aluminum ribbon supported along its length by the water obstacle. The Ribbon Bridge has a capacity to carry 60-ton loads. It can be transported by truck or helicopter, assembled with bridge erection boats, and employed at rates up to 10 times faster than float bridges in the current inventory, with one-half the personnel. A prototype for testing has been built by Pacific Car & Foundry Co., Renton, Wash., under a contract of approximately $1 million. Initial tests are underway on the Skagit River, Wash.

Construction Equipment

MECOM has the lead role in developing the technical approaches and outlining the administrative and procedural steps necessary to equip U.S. Army Engineer construction units with commercial construction equipment. The concept is to replace military design and modified commercial equipment with proven "off-the-shelf" commercial equipment and provide for its support.

Three items will be purchased under the pilot program: a 25-ton truck-mounted hydraulic crane, a 1,500-gallon bituminous distributor, and a 20-ton dump truck.

The plan takes advantage of industry's state-of-the-art advances to sat-

MULTI-PURPOSE CONSTRUCTION EQUIPMENT, needed by combat engineers, is under development at MERDC. This Universal Engineer Tractor can hold eight cubic yards of dirt in its self-loading ballast bowl, a squad of engineers, or 200 cubic feet of cargo.

isfy the need for equipment modernization. Dollar savings will be realized by substituting industry-generated data for government endeavors in the fields of research, development and testing.

For combat engineering tasks in forward areas, military design will continue to be necessary to achieve the high mobility, including airlift, and working flexibility required. Accordingly, development is continuing on the Universal Engineer Tractor (UET) designed to provide the combat engineer with an armored, multi-purpose earthmover capable of supporting armored and mechanized units. Though dozing, scraping, and hauling capabilities exceed original expectations, adequate reliability has not yet been demonstrated. Contracts have been awarded for competitive shakedown and evaluation tests of existing models, as a first step in a program to produce a reliable machine.

Development is beginning on FAMECE, a *F*amily of *M*ilitary *E*gineer *C*onstruction *E*quipment, to meet a wide variety of combat engineer tasks. This family will utilize a standardized, high-density power module capable of operating all of the construction work modules. In addition to the power module, seven work modules are to be developed—dozer, bucket loader, scraper, dumper, water distributor, compactor, and grader. Evaluation of two or three competitive prototypes is planned during the validation prototype phase of development.

Another development, a Repetitive Explosive Device for Soil Displacement, called REDSOD, represents a radical departure from traditional excavation concepts. REDSOD is basically a fuel-air combustion device that creates explosions beneath the surface of the earth at 6- to 10-second intervals, disaggregating the soil and displacing it. REDSOD may eventually be a kit designed for field installation on a standard tractor, or a device requiring the development of a special transporter. In tests conducted in highly cohesive, wet clay, it has displaced up to 11 cubic yards of soil per shot indicating that the eventual device may be capable of excavating earth more than 10 times faster than conventional equipment.

Other Troop and Field Support

Mobility and versatility are sought also in other troop and field support equipment. Versatile environmental control units are being developed for mobile vans and shelters housing highly sensitive electrical, electronic and medical equipment, as well as for combat and combat support vehicles. Development of vertical and horizontal families of compact air conditioners has been completed and certain family members are now in the field. Advanced development is underway on a unit which permits reduction of noise and maintenance by using solid state thermoelectric components instead of conventional vapor cycle compressors, and evaporator and condenser units. Development is also well along on a family of multi-fuel heaters for mobile vans and shelters.

In the area of environmental control, close technical support is provided other subordinate commands of the Army Material Command during development of combat vehicles, and elements of major systems, such as the inclosures housing radar and fire control of missile systems.

A 420-gallon-per-hour airmobile water purifier has been designed to meet urgent requirements in Vietnam. This is the smallest in the family of purifiers that has been effective, not only for the Army, but for communities stricken by floods and earthquakes. This unit can be carried in the cargo compartment of the UB–1B helicopter. Work is now underway in adapting the commercial reverse osmosis process to mobile water purification equipment. "Militarized" reverse osmosis gives promise of filling the Army's need for a mobile unit capable of removing all types of contaminants from all types of water.

Camouflage equipment under development ranges from concealment sets for missile systems to field-fabricated decoys. The program includes countering many types of sensors as well as visual concealment.

Work in the camouflage area benefits from the center's materials research program, which prescribes the paints, plastics, adhesives, and fabrics needed for modern camouflage devices, as well as the metals and other materials used in mobility support equipment. A significant achievement of the materials research program is the plastic sandbag developed for Vietnam. The life of this sandbag in Southeast Asia, as compared with burlap and cotton bags, has saved millions of dollars.

In-House Laboratory Independent Research

The center also pursues in-house laboratory independent research (ILIR) as a direct means for exercising discretionary emphasis in research and exploratory development. Efforts are now being made to expand this program. It is funded by the Assistant Secretary of the Army for Research and Development and administered by the center's Deputy for Research, Development and Engineering under broad guidelines. The aim of the ILIR program is to provide an adequate base of scientific and technological knowledge for future hardware development in the center's assigned fields of endeavor.

Work under the ILIR Program is performed within the center to give its scientists and engineers the opportunity to develop their ideas. Contracting, however, is not prohibited should it be required.

The foregoing briefly describes the work at the Mobility Equipment Command's Research and Development Center. The limited number of examples discussed are indicators of the complexity, and implicit challenge, of the mission of the center. Hopefully, they serve also to indicate the diverse areas in which industry may cooperate, to mutual advantage, in the accomplishment of this mobility support mission. In certain fields of endeavor, such as power generation, construction equipment, materials handling, environmental control and water supply, the opportunity for industrial participation is readily apparent. In others, camouflage and mine neutralization, for example, the industrial impact is not so evident. But in all, the talent, technical know-how, and facilities of industry are essential to a greater degree. The cooperation of industry in the development of mobility support equipment is a must, if our land combat forces are to maintain an advantage over any enemy, anywhere, anytime.

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Editor's Note: Organization charts appearing in the Bulletin are edited by the staff to reflect those elements which are of interest to industry representatives. Organizations not involved in the DoD-Industry relationship have been eliminated because of space limitation.

The information on personnel and telephone extension numbers is as current as is possible to obtain at the time we go to press.

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Contractor Performance Measurement

Major Robert R. Kemps, USAF

Defense Department directives, instructions, and other policy issuances which impact on the management of major systems acquisitions are currently undergoing a critical examination. The purpose of this review is to structure a family of directives oriented specifically to the weapon systems acquisition process and to eliminate, reduce, simplify, or consolidate existing directives wherever possible. A prime objective is to do away with reports, systems and programs which consume effort of project management personnel, but do not contribute directly to the development or procurement of the product.

About five years ago, the Assistant Secretary of Defense (Comptroller) took a similar look at the financial management information and reporting systems used in the major acquisition area. The results of this review convinced him that a single integrated financial management system was sorely needed to replace the myriad of unique reports and systems being employed by program managers within the military departments. Many of the systems in use were not particularly effective, and the proliferation of unique formats and reports which had resulted were causing great difficulties for industry and proving to be expensive to the government. In addition, the lack of standardized cost information was seriously hampering DOD's efforts to develop an independent cost estimating capability.

A working group consisting of representatives from the three military departments and staff offices of the Office of the Secretary of Defense (OSD) was formed in October 1965 to review existing systems and develop a framework for an integrated management information system which would satisfy the minimum requirements for program management. These minimum requirements were determined to be:

- Funds Management.
- Cost Estimating.
- Program Status.

Of these three functions, funds management is a matter of immediate and continuing concern to the DOD program manager. He must ensure that his program is adequately provided for in the Five Year Defense Program and in annual budgets. A program, not adequately funded, will require continual reprogramming often resulting in higher program costs, missed delivery schedules, or even degradation of the final product when desirable elements must be deleted due to lack of funds. The contractor also needs a vehicle which enables him to tell the government, on a periodic basis, what he estimates the contract funding requirements will be for both authorized and anticipated work.

The development of reliable cost estimates for decision making on new programs, follow-up buys, etc., is another important financial function which must be satisfied. For years DOD has employed a number of reporting systems designed to collect historical cost information by project, by contract, and by company facility. In 1961, DOD developed the Defense Contractors Planning Reports (DCPR) to replace a series of reports known as the Aeronautical Manufacturers Planning Reports (AMPR), the Missile Manufacturers Planning Reports (MMPR), and the Missile Support Equipment Manufacturers Planning Reports (MSEMPR). The DCPR, however, was never successfully implemented due to its scope, complexity, and level of detail required. A system to provide comparable cost data on major programs on a systematic basis was needed. Such information would then be stored in data banks at OSD and military service levels to be used for program cost estimating, using parametric estimating and other analytical techniques.

The third area of importance to DOD, particularly to DOD program managers, is the capability to accurately determine program status. The program manager absolutely must know where he stands on his program in terms of cost, schedule, and technical performance in order to make meaningful management decisions. A technique which would provide a depiction of the development or production plan in a way that would enable comparisons of actual cost, schedule, and technical performance was determined to be a necessity.

It was felt that in order to be most effective, the systems designed to satisfy the three functions just described should also be relatable to each other. In other words, the historical actual cost data must support the statements of funds requirements. The performance measurement information should indicate what the actual costs incurred really represent in terms of contract performance. The contractor's system must provide all of these data on a consistent, systematic basis. At that time, the Director, Defense Research and Engineering, was engaged in the development of standard work breakdown structures to be used as frameworks for all major systems acquisitions. The work breakdown structure provided the key integrating feature that permits reconciliations of individual reports with each other, directly supports the DOD budget structure, and represents the way work is actually being done by the contractor.

A final decision made by the Assistant Secretary of Defense (Comptroller) was that DOD should get out of the systems design business. DOD experience with PERT (Program Evaluation and Review Technique) cost had been largely unsuccessful for a number of reasons. For example, many contractors did not implement the system according to the instructions. Rather than using a work breakdown structure to identify and define the work, they tried to assign budget values to PERT network activities. Unfortunately, these activities do not always lend themselves to being costed out and the result was unsatisfactory. Second, many contractors were unwilling to give up their own internal management control systems which had evolved over a number of years. This frequently led to the establishment of a "PERT Cost Group" whose main purpose was to transpose data from the contractor's management system into PERT cost formats and reports. In some cases, critical information got "lost" in this transposition which came to be known as the "judgment link." In addition to this, there were some deficiencies in the PERT cost technique itself which made the reports less than satisfactory, even when all the directions were properly followed by the contractor.

For these reasons, it was decided that DOD should rely on the contractor's internal management system rather than attempt to impose a DOD invented system on him. However, it was also agreed that the contractor's system should be evaluated to make sure that it was a good one and produced reliable data on a timely basis. In order to make such an appraisal, a set of management standards or criteria was needed. Experiments with criteria or management specifications had been conducted by the Air Force on a number of programs, and had already provided enough information to indicate that this was a realistic and promising approach.

Financial Management

A number of systems and techniques have now evolved which are intended to satisfy the financial management functions previously discussed.

The Contract Funds Status Report was developed to provide the data needed for funds management. This is a one-page report obtained from a contractor on a quarterly basis. It provides estimates for all authorized work whether definitized or undefinitized. It also provides contractor estimates for anticipated work whether proposed or yet to be proposed. This information provides the DOD program manager with a starting point for formulating his budget requests.

The cost estimating function is now being satisfied by two reporting systems: the Cost Information Reports (CIR) and the Procurement Information Reports (PIR). Although similar in appearance, there is no duplicative reporting involved since only one system may be used on a given program.

The CIR reports are applied only to major programs; those estimated in the Five Year Defense Program to require development funds in excess of $25 million or production funds in excess of $100 million. The reporting is also limited to the top three levels of the work breakdown structure; *i.e.*, airframe, propulsion, etc.

PIR, on the other hand, may be applied to smaller programs and to greater levels of detail than CIR. PIR was developed because CIR did not provide an adequate level of detail for procurement pricing analysis.

Two significant differences are apparent between CIR and PIR. CIR requires reporting of "incurred costs" (cost of only the labor and materials actually used in completed work), while PIR accepts whatever costs the contractor's accounting system provides. This may consist of disbursements or expenditures rather than incurred or applied costs. It is important, therefore, that the contractor clearly state the basis on which his costs are reported if PIR data are to be comparable across programs. The other difference involves the work breakdown structure. CIR occasionally requires unique aggregations of data to ensure comparability across programs. PIR accepts reporting in accordance with the established contract work breakdown structure and does not require special aggregations.

Neither CIR nor PIR are particularly useful for program management purposes, but are primarily required to support initial program decisions, decisions on production options, contract pricing and negotiations, etc.

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Program Status

The program status function contains two separate elements. The Cost/Schedule Control Systems Criteria (C/SCSC) which establish the standards of acceptability for the contractor's internal cost/schedule control system and the Cost Performance Report (CPR) which enables the DOD program manager to obtain information from these systems. The criteria themselves do not require any output reports from contractors, but simply specify capabilities which contractors' management systems must possess and the types of data which the system should be capable of producing.

The Cost Performance Report enables the program manager to collect summary level cost and schedule status information. Variances between planned and actual costs and schedules are displayed for elements at level three of the work breakdown structure. The program manager may, however, request more detailed information in areas where problems are indicated. The basic intent of this procedure is to require only summary level information to be reported as long as the program is proceeding according to plan. When deviations from plan occur, the contractor's system should provide the traceability to isolate the problem area and clearly show the cost impact on the progam.

Although there are a number of criteria applicable to a contractor's internal systems, the basic requirements can be boiled down into a few brief statements.

Every contractor has systems for budgeting, scheduling and authorizing work, and an accounting system for accumulating costs. In many cases, however, these systems were developed independently and may even operate independently of each other. One fundamental requirement of the C/SCSC is that these systems be integrated. This simply means that a work authorization should contain an appropriate budget and schedule, and that costs should be accumulated on the same basis as the budgets to enable comparisons of planned versus actual costs to be made. The work breakdown structure provides the framework for carrying out these activities and for reporting to progressively higher levels of management and the government.

Probably the most basic concept contained in the criteria is that of basing contract status strictly on the number of jobs completed to date. The lowest level job assignment device in most contractors' plants is normally the shop order, engineering work order, task authorization, or similar document which describes the task. These lower level jobs are referred to in the criteria as work packages. By adding up the budgets for completed work packages along with an estimate for the amount of in-process work completed, an objective value of work accomplished can be determined. Comparing actual costs incurred to this value of work performed provides a clear picture of the cost position at a point in time. Trends can be analyzed to ascertain whether the cost position is improving or deteriorating from period to period. The important point is that status is measured as objectively as possible and is not merely a subjective evaluation of percentage complete.

The criteria do not normally require any adjustments to a contractor's accounting system as long as he can aggregate costs directly from the bottom up utilizing procedures acceptable to the Defense Contract Audit Agency. The system must, however, be able to provide applied direct costs which represent the cost of only those resources actually consumed for work accomplished. Such costs do not include the cost of materials purchased, but not yet issued from inventory for use. There are several reasons for the requirement to report applied costs. For performance measurement, the objective is to compare actual costs to planned costs for work performed. Including the value of the inventory in the actual costs provides a distorted relationship which is not truly representative of work performed.

Applied costs are also needed in the determination of actual unit cost for completed end items or components. Such information is required for estimating costs of follow-on buys, spares, etc. For this reason the Cost Information Reports also require reporting in terms of applied direct costs.

A third reason for the applied direct cost requirement is to improve material control procedures. In many instances, contractors were found to lose interest in financial accountability for material after the material was received and invoices were paid. Final disposition of the material was uncertain in some instances and an accurate determination of usage cost variances was not readily available.

The reason behind all of the individual requirements in C/SCSC is to allow the comparison of actual costs to a meaningful plan which is representative of the contractual commitment and the manner in which the work is done. This plan is commonly called the baseline and is made up of budgets assigned to time-phased (scheduled) increments of work, usually aggregations of work packages. Proper establishment and maintenance of the budget baseline is essential to this concept of performance measurement.

The Cost Performance Report is the vehicle which takes the planned versus actual information and presents it in a form useful for management. Figure 1 shows the top three levels of the work breakdown structure for an aeronautical weapon system. In this illustration, the total contract block represents the entire weapon system being procured. The graphic display in the top block is representative of a plot of the information provided by the Cost Performance Report. Three elements are plotted: the actual cost, the budgeted cost for work scheduled (this represents the baseline plan), and the budgeted cost for work performed (commonly referred to as the "earned value"). The difference between the budgeted cost for work scheduled (BCWS) and the budgeted cost for work performed (BCWP) represents a schedule variance. Or, put another way, the difference between BCWS and BCWP is the value of the work that didn't get done.

The difference between the budgeted cost for work performed and the actual costs is the cost variance—the overrun or underrun to date. Comparing actual costs to budgeted cost for work scheduled, which is the old budget versus actual comparison, does not give a true picture of the cost

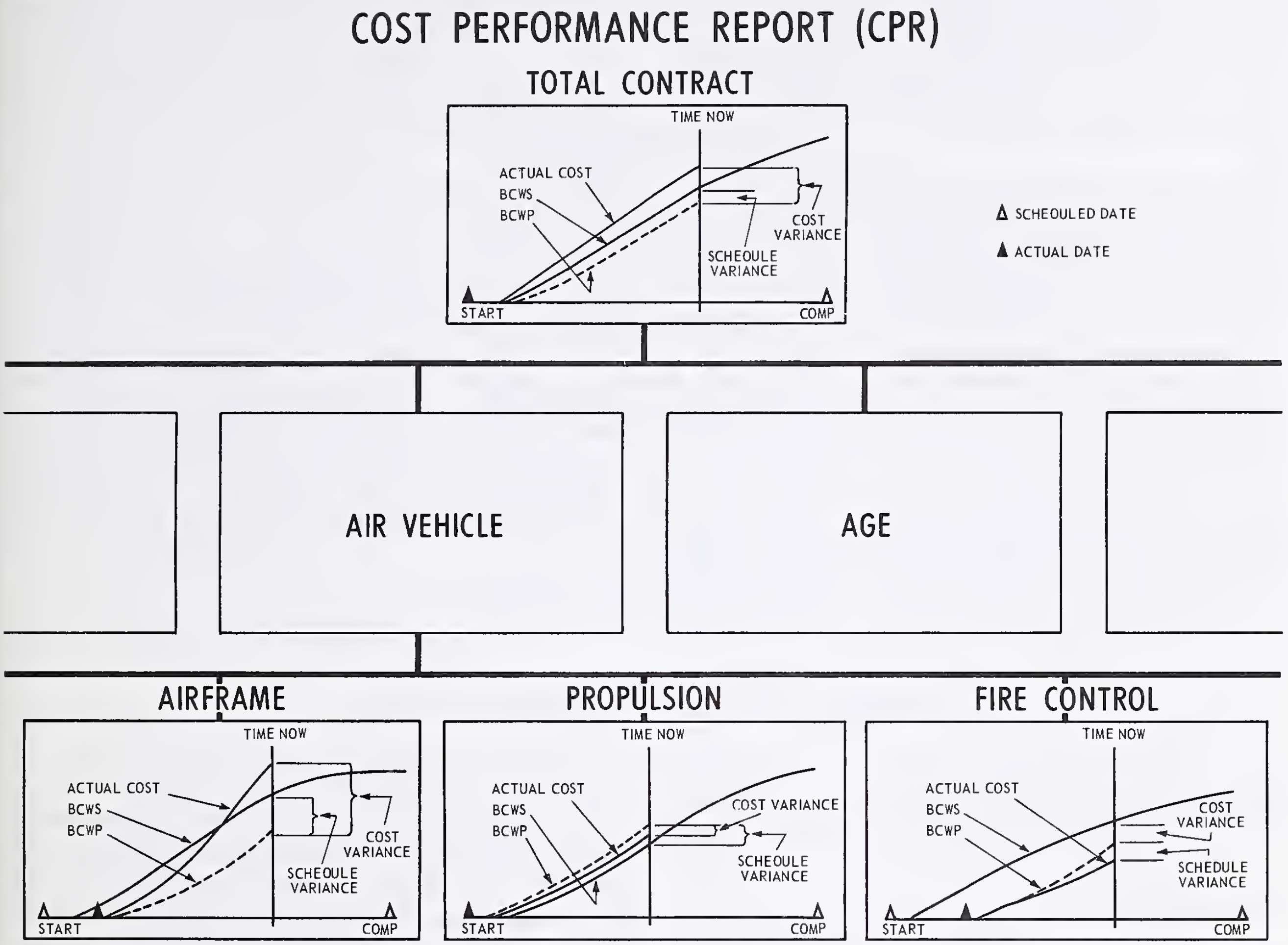

Figure 1

status of a contract. It simply tells whether or not money is being spent as fast as it was planned to be spent, and does not take into consideration the schedule conditions. The budgeted cost for work performed quantifies the schedule position in terms of planned cost and provides a much more accurate cost picture.

The Cost Performance Report normally provides BCWS, BCWP, and actual cost information for each element at level three of the work breakdown structure. In Figure 1, airframe, propulsion and fire control are representative of level three items. Only a glance is required to identify that problems are occurring in the airframe area. The contractor should be able to provide additional similar information for work breakdown structure elements below airframe. This traceability should clearly pinpoint the exact component and functional area experiencing difficulties.

Measurement Baseline

During the past few years, DOD has evaluated a large number of contractors' systems. Many contractors have been unable to meet the criteria. In almost every case, the primary reason for failing the evaluation was the inability of the contractor to establish and maintain a valid measurement baseline.

When performance is deviating from plan, a common tendency is to change the plan so that it resembles actual performance. This is done by shifting budgets from one piece of work to another or by allocating budget in excess of the contract value. Using budget originally programmed for downstream work to cover today's problems is commonly referred to as the "rubber baseline." Even though this term became a cliche long ago, various manifestations of this practice are found today. Allocating budget in excess of the contract target cost is simply a "built-in overrun" and tends to disguise the real cost position by making "earned values" meaningless.

Failure to maintain a valid budget baseline is mainly a problem of discipline within the budgeting system. Management emphasis within the contractor's plant is the only thing that will overcome this problem. No amount of management techniques, criteria, or requirements will make a system work effectively if it does not contain such discipline. In the case of the Cost/Schedule Control Systems Criteria, the budget baseline is the essential requirement which must be met.

In summary, the Defense Department has developed reporting systems and management techniques designed to satisfy only the most basic financial management needs of the program manager. Funds management and program status are essential elements for program management. Cost estimating is needed to assist in making program decisions for future investments.

The approach taken by DOD was to develop a single integrated management information system. Use of integrated work breakdown structures enables reconciliations of cost data between reports and between programs. In addition, the work breakdown structure directly supports the DOD budget process and the Five Year Defense Program.

Standardized cost reporting is required to prevent a proliferation of unique reports which ultimately cause many problems for both DOD and defense contractors. Violations of the Federal Reports Act are another problem. And, finally, cost reports which provide non-standard data, with each program racking up costs in different ways, seriously hamper DOD's efforts to develop a viable independent cost estimating capability.

The Cost/Schedule Control Systems Criteria set the standards for contractor's internal management control systems. The criteria do not impose a system on the contractor nor do they prescribe proceduralized management methods or techniques.

A final point worth noting is that, in the development of the cost reporting systems for major acquisitions, the Office of the Secretary of Defense, has acted primarily as a coordinating agent for the military services in gaining the formal approvals needed. The Contract Funds Status Report, the Cost/Schedule Control Systems Criteria, the Cost Performance Report and the Procurement Information Reports were all developed primarily within the military departments, coordinated and formalized by the Office of the Secretary of Defense, and then reissued to the military services for their use in appropriate DOD instructions. This is considerably different than having the Office of the Secretary of Defense invent a system which is then imposed on the military services. This is the approach which will be followed to the maximum extent in the future.

Cost/Schedule Control Systems Criteria

The contractors' management control systems will include policies, procedures, and methods which are designed to accomplish the following:

Organization

- Define all authorized work and related resources to meet the requirements of the contract, using the framework of the contract work breakdown structure (CWBS).
- Identify the internal organizational elements and the major subcontractors responsible for accomplishing the authorized work.
- Provide for the integration of the contractor's planning, scheduling, budgeting, work authorization and cost accumulation systems with the CWBS and the organizational structure.
- Provide for reliable performance measurement at the level where the work is performed.
- Identify the managerial positions responsible for controlling overhead (indirect costs).
- Provide for integration of the WBS with the contractor's functional organizational structure in a manner that permits cost and schedule performance measurement for WBS and organizational elements.

Planning and Budgeting

- Schedule the authorized work in a manner which describes the sequence of work and identifies the interdependencies required to meet the development, production, and delivery requirements of the contract.
- Identify physical products, milestones, performance goals, or other indicators that will be used to measure output.
- Establish budgets for all authorized work to the lowest level of contract planning with separate identification of cost elements (labor, material, etc.).
- To the extent the authorized work can be identified in discrete, short-span work packages, establish budgets for this work in terms of dollars, hours, or other measurable units. Where the entire cost account cannot be subdivided into detailed work packages, identify the far term effort (beyond six months) in larger planning packages for budget and scheduling purposes.
- Identify relationships of budgets or standards in underlying work authorization systems to budgets for work packages.
- Identify level of effort activity in cost ac-

counts which are planned and controlled by time-phased budgets established for this purpose. Only that effort which cannot be identified as discrete, short-span work packages or as apportioned effort will be classed as level of effort.

- Establish overhead budgets on a basis consistent with the way resources are to be consumed and accounted for.
- Identify management reserves and undistributed budget.
- Provide that the contract target cost plus the estimated cost of authorized but unpriced work is reconciled with the sum of all internal contract budgets and management reserves.
- Establish and maintain a performance measurement baseline consisting of budgets assigned to scheduled cost accounts. For cost accounts that exceed one year in duration, establish smaller budget planning packages for baseline planning and controls.
- Provide that the sum of all work package budgets plus planning packages within a cost account equals the cost account budget.

Accounting

- Record applied direct costs on a basis consistent with the budgets in a formal system that is controlled by the general books of account. Include within the cost accounts the amounts charged to work in process in the time period when: (1) Labor, material and other direct resources are actually consumed; or (2) Material resources are withdrawn from inventory for use; or (3) Material resources are received that are uniquely identified to the contract and scheduled for use within 60 days; or (4) Major components or assemblies are received on a line flow basis that are specifically and uniquely identified to a single serially numbered end item.
- Summarize applied direct costs from cost accounts into the WBS without allocation of a single cost account to two or more WBS elements.
- Summarize applied direct costs from the cost accounts into the contractor's functional organizational structure without allocation of a single cost account to two or more organizational elements.
- Record all indirect costs which will be allocated to the contract.
- Identify the bases for allocating the cost of apportioned effort.
- Identify unit and equivalent unit costs and/or usable lot costs.
- Reconcile original budgets for those elements of the WBS identified in the contract for reporting to the Government with current budgets in terms of changes to authorized work.

Analysis

- Identify at the cost account level on a monthly basis using data from, or reconcilable with, the accounting system: (1) budgeted cost for work scheduled and budgeted cost for work performed; (2) budgeted cost for work performed and applied direct costs for the same work; (3) variances resulting from the above comparisons classified in terms of labor, material, or other appropriate elements together with the reasons for significant variances.
- Identify on a monthly basis in the detail needed by management for effective control, budgeted indirect costs, actual indirect costs, and variances along with the reasons therefor.
- Summarize the data elements and associated variances listed in the two above paragraphs through the contractor organization and WBS to the reporting level specified in the contract.
- Identify on a monthly basis significant differences between planned and actual schedule accomplishment and planned and actual technical performance, with the reasons therefor.
- Identify managerial actions taken as a result of the above criteria items.
- Monitor the effectiveness of actions taken to resolve problems or correct deficiencies.
- Based on performance to date and on estimates of future requirements, develop revised estimates of cost at completion for WBS elements identified in the contract and compare these with the contract baseline budgets, contract price and latest statement of funds requirements reported to the Government.

Revisions and Access to Data

- Incorporate contractual changes in a timely manner recording the effects of such changes in budgets and schedules. In the directed effort prior to negotiation, base such revisions on the amount estimated and budgeted to the functional organizations.
- Prohibit retroactive changes to records pertaining to work performed that will change prev-

iously reported amounts for applied direct costs or indirect costs, except for correction of errors and routine accounting adjustments.

- Prevent revisions to the contract budget baseline except for government directed changes to contractual effort, *i.e.*, scope, work, and schedule.
- At the time changes occur, advise the procuring activity of any changes to baseline budgets or schedules.
- Work packages that have been opened will not be changed; work packages that have been closed will not be reopened. Any changes in unopened work packages will be accompanied by documented explanation of budget and effort moved.
- The contracting officer and his duly authorized representatives will be provided access to all of the foregoing information and records in support thereof.

DCAS Role in Contractor Performance Measurement

Nathaniel Ligols
Commander Robert L. Ediin, USN

As competition for budget dollars becomes keener, weapon system acquisition becomes more selective. The need to assure maximum effectiveness and utilization of each dollar spent by DOD becomes of increasing importance. As weapon systems become more sophisticated and costly, management control must achieve maturity and flexibility to adapt to the increased sophistication.

The Defense Contract Administration Services (DCAS) of the Defense Supply Agency and the contract administration offices of the military departments play an important role in assuring control of program costs and schedules.

Essentially, the problem has become one of timeliness in program visibility, particularly focused on the areas of cost, schedule, and technical performance.

Effective weapon system management requires an exchange of common dialogue between the government and the contractor in the areas of cost, schedule, and technical performance. Recognizing this fact, DOD Instruction 7000.2 "Performance Measurement for Selected Acquisitions" was issued in December 1967.[1]

The application of the requirements of this instruction would satisfy the need for a common communication link by assuring that the data utilized at the lowest level of contractor management was the same data used to prepare reports required at the highest DOD levels. DOD Instruction 7000.2 departs from previous attempts at control by defining an adequate management control system in terms of criteria rather than a specific or rigid framework, *i.e.*, PERT, Line of Balance, etc.

Because of differences in complexity, dollar value, and uncertainties involved, not all procurements require the same level of attention by DOD program managers. Therefore, the Cost/Schedule Control Systems Criteria (C/SCSC) of DOD Instruction 7000.2 are invoked only on selected contracts. The criteria are usually invoked on critical weapon system acquisitions being procured on other than firm fixed price contracts and meeting estimated dollar thresholds in the Five Year Defense Program of $100 million for production programs and $25 million for research, development, test, and evaluation (RDT&E) programs.

DOD Instruction 7000.2 does not prescribe a specific management control system; it only describes in terms of criteria what an acceptable system must accomplish. Because of differences in contractors' product lines, management philosophies, organizational structures, and individual personalities of key people, management control systems are unique to each contractor.

The contractor must have only one management control system, *i.e.*, the information furnished the government must be produced from the system used by the contractor for his own internal management. To be effective, the flow of management in-

[1] *Further amplification relative to its implementation can be found in the tri-Service pamphlet, "Cost/Schedule Control Systems Criteria (Joint Implementation Procedures)", AMCP 37–5, NAVMAT P5240, AFSCP 173–3, Aug. 26, 1970. The pamphlet is available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; order no. D301.35/3; 173–3; price 70¢.*

formation data must be current, accurate, and reconcilable to its source. Another important feature of the management control system is that it must have the capability of tracing a problem to its source. Specifically, the contractor's system must be able to provide:

- Budgeted cost for work schedule.
- Budgeted cost for work performed.
- Actual cost of work performed.
- Budgeted cost of total contract.
- Latest estimate of cost at completion.
- Contract cost and schedule variances.

Among the specific tasks to be accomplished in framing a management control system in accordance with DOD Instruction 7000.2 are:

- Translation of the contract work statement into an appropriate work breakdown structure (WBS) per MILSTD 881 "Military Standard Work Breakdown Structures for Defense Material Items."
- Identification of the work in terms of discrete work packages, level of effort, or apportioned effort, as suitable.

Essentially, DCAS participates in two stages of performance measurement surveillance, *i.e.*, Phase I and Phase II. Surveillance Phase I begins immediately after contract award and encompasses the period of performance measurement up to the actual validation of the contractor's management control system. Surveillance Phase II begins immediately after system validation and continues through the life of the contract. Although the primary DCAS responsibilities are in surveillance, DCAS may also be asked to comment on the contractor's management control system during the proposal evaluation stage.

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Proposal Evaluation

Proposal evaluation covers the period prior to contract award. The Request for Proposal (RFP) contains a clause delineating the requirement for a management control system meeting the specified criteria of DOD Instruction 7000.2. In the source selection process, the cognizant military department evaluates the contractor's responsiveness to the Cost/Schedule Control Systems Criteria. When a DCAS plant is involved, DCAS may, on occasion, be called upon to assist in this evaluation. To be considered responsive to the C/SCSC requirements contained in an RFP, the contractor must describe in detail how his present management control system complies with the criteria, or how he plans to modify and/or upgrade his present system so that it will comply.

Surveillance Phase I

Upon notification of award, the contractor immediately begins to upgrade or modify his management control systems in accordance with his plan submitted in response to the RFP. During this period there is frequent liaison between the military departments, the contractor, and the DCAS activity. The purpose of this liaison is to expeditiously upgrade the contractor's system to the point where it can be validated in accordance with the C/SCSC. A series of implementation reviews are conducted by the cognizant military department until it is felt that system validation is possible. At this point a series of readiness reviews resolve obvious misunderstandings between the contractor and the military department. Additionally, the contractor's written procedures are evaluated for adequacy and feasibility in accordance with the C/SCSC requirements. A successful readiness review indicates that a contractor can operationally demonstrate that his system functions in accordance with his written procedures and will meet the criteria set forth in DOD Instruction 7000.2.

The DCAS representative is an important and active participant during this phase and maintains liaison with the contractor and the military department involved.

When indicated, a formalized team comprised of representatives of military departments, DCAS and the Defense Contract Audit Agency (DCAA) evaluates the contractor's management information and control systems, procedures, and operations against the requirements of DOD Instruction 7000.2. This stage in the program is called the demonstration review and, when successfully completed, is a certification that the contractor's system has achieved the effectiveness and reliability required by the C/SCSC program. The DCAS

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representative is a full-time active member on this team.

Because of the need to define the respective responsibilities of DCAS and the cognizant military department during surveillance, a memorandum of agreement is negotiated between them. In order that a definitive program for surveillance is implemented and that all DCAS participants understand their daily individual responsibilities in this program, a surveillance plan is established within the DCAS organization.

Surveillance Phase II

Essentially, the DCAS organization has three functions in this phase. First is to assure continued system compliance with the criteria. Second is to assure the validity, timeliness, and usefulness of system-produced data. Third is to perform detailed data and trend analysis in support of program management and surveillance. Some specific DCAS surveillance functions are to assure:

- Rigid maintenance of the Performance Measurement Baseline. The Performance Measurement Baseline is the time-phased dollar budget plan against which contract performance is measured.
- Proper control and application of Management Reserve. Management Reserve is an amount withheld from the target cost for management control purposes. Changes in Management Reserve highlight unplanned occurrences.
- Detailed and accurate planning techniques.
- Accurate and disciplined techniques to establish estimates of completion milestones.
- Timely and accurate incorporation of contract changes, as well as any internal contractor rearrangements which do not require changes to the contract.
- Timely and accurate re-programming actions, if required.
- Reconciliation of all external reports to the government with the system data base, and with internal reports used by the contractor's management.
- Effective contractor variance analysis.
- Identification and correction of management control system discrepancies. Any deviations from procedures validated during the demonstration review will be brought to the contractor's attention for correction. If a satisfactory resolution cannot be accomplished between DCAS and the contractor, the problem will be referred to the program office for final resolution.

The focal point within the DCAS organization for all C/SCSC matters pertaining to a particular contract is the C/SCSC monitor. Assisting the C/SCSC monitor are the representatives of the functional elements within the DCAS organization, *e.g.*, quality assurance, production, contract administration, and engineering. The DCAA auditor, although not part of the DCAS organization, is an indispensable adjunct to the monitoring team. He performs as the expert in all accounting system matters and data reconciliation.

The team's activity depends upon the number and type of problem areas encountered through system monitoring. If the program is operating within acceptable controlled limits, the team will function in a low-key manner, concentrating mainly on monthly sampling to verify system integrity. On the other hand, if significant variances develop, or the program office requests a special analysis, the DCAS team will devote the necessary effort to accomplish a satisfactory evaluation.

In summary, the DCAS role in the performance measurement program consists of:

- Participation in proposal evaluation as requested by the cognizant military department to clarify contractor intent in response to the RFP.
- Participation in the surveillance Phase I as a team member in implementation, readiness, and demonstration reviews. Monitoring contractor progress during the implementation process. Preparation of a formal surveillance plan for Phase II surveillance.
- Conducting Phase II surveillance after validation in accordance with the surveillance plan and memorandum of agreement with the program office. Assuring maintenance of integrity of the contractor's management control system.

DCAS is committed to various C/SCSC programs of the 3 military departments in approximately 26 DCAS plants. Major weapon systems on which DCAS participates are: Minuteman III, Titan III, Hawk, SAM–D, AN/TSQ–73, SATCOM, Safeguard, Main Battle Tank, Aegis, USAF Defense Support Programs, and LVT–P7.

Industrial Defense, Disaster Planning Courses Offered

The schedule of classes for the Industrial Defense and Disaster Planning for Privately Owned and Operated Facilities Course, FY 1972, has been confirmed. The five-day, tuition-free course will be given to industry and government executives at the Army Military Police School, Fort Gordon, Ga.

Reporting dates are Aug. 29 and Nov. 14, 1971; Jan. 30, March 19, April 16, May 7, May 14 and June 4, 1972.

The course will provide a working knowledge of planning measures to safeguard industrial facilities from hostile or destructive acts.

Subjects will include the industrial defense program, natural disasters, nuclear weapons, mutual aid, disaster control operations, emergency communications, industrial physical security planning, corporate survival, and disaster plan test. Also covered will be legal aspects of civil disturbance, and planning for civil disturbances.

Priority will be given to executives of private facilities participating in the DOD Industrial Defense Program, and to government personnel whose duties include national emergency, mobilization, or disaster planning. No security clearance will be required.

Accommodations have been arranged at a local motel. Daily transportation will be provided.

Executives whose faciities participate in the DOD Industrial Defense Program should send their applications to the Army Headquarters which conducts surveys of the programs at their facilities. Other industrial representatives and Federal, state and local governmnt officials should apply to: The Provost Marshal General, Department of the Army, ATTN: PMGS–D, Washington, D.C. 20314.

Inspector General Evaluates Program Management

Lieutenant Colonel William L. Haygood, USAF

The Air Force has recently emphasized the use of one of its oldest management resources—the Office of the Inspector General—to assess the latest management trends in acquiring major weapon systems. The Air Force Inspector General (IG) was directed to conduct a new type of inspection called Program Management Evaluation (PME). In 1970, the first two PMEs were conducted on major Air Force weapon systems. Since PMEs are directed by the Chief of Staff of the Air Force, they enjoy a very high priority for the inspection resources of the IG.

A Program Management Evaluation is formally defined as "a total evaluation of all government and contractor activities involved in a given system/subsystem. This evaluation encompasses all functional areas throughout the life cycle of the system/subsystem program." A PME team consists of about 50 inspectors who spend about 2 months inspecting a selected program.

Previously, one of the major efforts of The Inspector General was to conduct Industrial Management Assistance Surveys which were essentially reviews of the effectiveness of the prime contractor's total management and plant operations in relation to government contracts. Similarly, the IG conducted system program inspections to evaluate the management and progress of Air Force agencies in attaining program objectives. However, as the program management process grew so complex and government and contractor actions developed interrelations, it became increasingly difficult to examine contractor and Air Force actions separately.

The primary purpose of a PME is to identify problems and latent deficiencies in evolving aerospace systems *before* the Air Force is so firmly committed that it has no maneuvering room. An effort is made to schedule the inspection at the point in the life cycle of the program between the preliminary design review and the physical configuration audit. Because of the depth of the evaluation, preparation time, report-writing time, and limited numbers of inspectors available, no more than two PMEs are attempted by the Air Force IG annually.

The IG in the PME role is marked by impartiality. The IG alone does not select the system to be evaluated. Selection is made by a Headquarters, USAF, committee chaired by the Deputy Chief of Staff for Research and Development, and comprising the Deputy Chief of Staff for Systems and Logistics, the USAF Comptroller, and The USAF Inspector General. As an agency outside the weapons acquisition process, the IG Office has no vested interest in protecting or attacking a given program and, thus, can be objective in the evaluation.

Officers chosen for duty as inspectors are qualified, both by education and practical experience. During recent years the IG has taken two actions to improve its staff of inspectors. Younger officers with much of their careers still ahead of them are being selected to build up an inspection staff more receptive to new management ideas. Also, the tour of duty for inspectors has been shortened from three to two years, so that an inspector's knowledge of his specialty does not become obsolete.

To illustrate the depth of a PME team, a recent weapon program evaluation, headed by the Deputy Inspector General for Inspection and Safety, included the following skills:

Electronics Engineer
Avionics Engineer
Guidance and Control Engineer
Aerospace Ground Equipment Engineer
Astronautical Engineer
Aeronautical Engineer
Aerodynamicist
Propulsion Engineer
Materials Engineer
Armament Systems Engineer
Reliability and Maintainability Engineer
Research and Development Director
System Program Manager
Computer Systems Analyst
Management Analyst
Flight Surgeon

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Administrator
Comptroller
Civil Engineer
Supply Officer
Procurement Officer
Budget Officer
Safety Officer
Auditor
Intelligence Officer
Air Operations Officer
Fighter Pilot
Munitions Officer
Manpower Officer
Education and Training Officer

What a PME Team Looks For

Every aspect of a PME cannot be discussed in this article. However, a few typical areas of evaluation will be mentioned to give the reader an overall view of the PME effort.

A definition of requirements attempts to match the threat postulated by U.S. intelligence estimates, while keeping one eye on expected advances in technology. A major concern is the currency of the game plan: Have changes in the threat or in technology occurred which invalidate the present solution?

Most program control offices do an effective job of handling documentation and reports, and of tracking program status to give visibility to the system program director. Few program control offices realize their potential in analyzing data from the contractor, in performing independent estimating and in forecasting. A PME team asks if the program control office is able to anticipate and answer "what if" type questions.

In financial management, the System Program Office (SPO) must cope with cost estimating, service funding, variances, and cost to completion. Recent IG emphasis is on the use of Cost/Schedule Control Systems Criteria in demonstrating and validating contractors' management systems.

The system engineering process should provide early identification of system objectives, design requirements, ultimate system configuration, and support required. Specific design disciplines such as reliability, maintainability, survivability/vulnerability, safety, transportation, and human performance should be coordinated to meet the requirements as spelled out in specifications describing intrasystem interfaces.

System safety engineering has received continuous emphasis from the IG. Safety requirements must be recognized early and included in the contract. When a subcontractor conducts a component or fault hazard analysis for submittal to a contractor who, in turn, conducts a functional or fault tree analysis, the compatibility of the two analytical methods must be reviewed to determine if critical or catastrophic events lose their identity when the analyses are integrated.

Configuration managers must identify, control, and account for technical requirements defining systems, equipment, and changes thereto. Critical examination will be made of the functional requirements baseline, performance of the Configuration Control Board, role of the Air Force Plant Representative, and handling of engineering change proposals.

System test and evaluation should determine whether the product is practical, reliable, and safe, and whether it meets specifications. Appropriate test results should be available at decision points. Test planning should occur well ahead of testing, and test costs should be well defined. The advent of service funding—the user pays—makes better planning imperative.

Procurement practices will be examined in detail, starting with an assessment of whether the type contract employed is consistent with the risk involved. Such contract administration functions as quality assurance, production surveillance, inspection and acceptance, and contract modification negotiations will also be rated. Timeliness of program direction and funding releases are also critical.

The integrated logistics support plan should be the blueprint for obtaining necessary maintenance, supply, and transportation functions for the program. The interface of Air Force Systems Command and Air Force Logistics Command will be closely examined.

The personnel subsystem should so develop the manpower, personnel, and training functions as to establish the grade and skill requirements to man the system with qualified, trained people on time. The primary planning instrument is the Qualitative and Quantitative Personnel Requirements Information document. Manpower requirements should be projected through the system life cycle. Training equipment should be available when needed.

Evaluation in the civil engineering area will include reviews of the Air Force concept for facility support requirements; the management of real property at government-owned, contractor-operated industrial facilities; and contractor proposals for production facilities. When a requirement for new facilities has been identified, aggressive and timely action will be necessary through the military construction program to provide adequate acquisition lead time.

Inspection of security procedures includes scrutiny of the classification guide, evaluation of the industrial security program, and a ferreting out of lax security practices.

The foregoing is not all-inclusive but does indicate some of the areas to which a PME would be applied.

PME Activity

Considerable time is needed for a team to conduct such a comprehensive evaluation. Preparation begins two or three months ahead of time, and the month immediately prior to the inspection is one of intensive research of background materials by the team. While on the road inspecting, the team attempts to examine virtually every facet of the program.

On one PME, the following organizations were visited by team members:

Headquarters, USAF.
Headquarters, Air Force Systems Command.
System program office.
Major using command.
Airframe contractor.
Engine contractor.
Two subcontractors.
Three test centers.
Two training centers.
Two logistics bases.

Many management deficiencies are identified by examining program files and interviewing personnel involved with a program. The different organizations involved in a program frequently may find themselves in honest disagreement as to how details of the program should be handled, and they are not reluctant to argue the merits of their position to the IG team.

Sometimes a particular problem will have been recognized prior to the arrival of the IG team; however, mere recognition of a problem is not enough. A solution must be found and pursued until the problem no longer impedes success of the program.

Another useful IG technique is cross-talk between inspectors during team meeting. An engineering inspector may have detected a manpower problem, for example, which he relays to the manpower inspector for further investigation. Such teamwrok greatly increases the efficiency of the inspection.

The deliverable product of a PME is a report prepared in two sections. The Air Force section contains those management deficiencies which involve the government, while the industrial section contains those for which contractors are responsible.

Each discrepancy is written in the form of a "finding" which states the condition needing improvement, what caused it, and what effect it will have on the program. Validation of a finding requires that the inspector and the persons against whom the finding is written reach agreement that the facts contained therein are correct.

A PME requires so much advance preparation that those responsible for the program to be inspected are alerted well in advance. The team does not attempt to surprise the personnel working on a program, or to catch them off guard. The contractor is notified in advance, as is the SPO. The team provides guidelines for briefings the contractor is expected to give during the evaluation. An advanced party of inspectors visits the SPO to collect information and background documentation. The System Program Director is asked at that time to identify to the team any specific areas he would like to have the team emphasize.

PME inspectors are most concerned with management attaining quality results. It is entirely possible to mismanage a program by misapplication of a regulation, when the regulation does not fit the problem at hand.

The team is free to judge management pragmatically on results attained. As Emerson remarked, "A foolish consistency is the hobgoblin of little minds." The PME places a premium on the results of management, not the form of management.

IG experience on PMEs conducted to date indicates that scheduling the evaluation early in the acquisition cycle allows the SPO time to incorporate program management changes during development stages. Benefits to the Air Force are obviously greater if mistakes can be prevented rather than corrected after the fact.

It would certainly be overstating the case to claim that program managers enjoy having The Inspector General evaluate their programs. Few do. Having one's mistakes underlined is seldom pleasant. However, considering the larger perspective and the nation's interests, Program Management Evaluations result in better managed aerospace systems and a stronger defense posture.

AF Contract Maintenance

(*Continued from page 22*)

government representative can authorize the contractor to purchase a replacement part on a cost reimbursable basis, or the government may elect to furnish a replacement from its own inventory with no contract cost involved.

In any case the Maintenance Center's experts are there to consider the alternatives and options so as to achieve maximum efficiency.

Under the terms of government contracts, contractors are ultimately responsible for performing the work. However, recognition is given to the fact that maintenance contracts are a unique partnership—a partnership requiring clear delineation of responsibilities and authorities but with built-in flexibility.

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Logistics Commanders Express Procurement Attitude for 1970s

"Successful procurement depends to a great extent on the personal attitude of each and every person who influences the procurement process. Every step of this process involves personal decisions. Each decision maker's personal attitude affects the quality of his decision."

With this introduction, the commanders of the four military logistics commands expressed their procurement attitude for the 1970s in a recent letter to procurement and logistics personnel worldwide.

The letter was signed by General H. A. Miley Jr., Commanding General, U. S. Army Materiel Command; Admiral J. D. Arnold, Chief of Naval Material; General George S. Brown, Commander, Air Force Systems Command; and General Jack G. Merrell, Commander, Air Force Logistics Command.

As expressed by the joint logistics commanders, the procurement attitude for the 1970s must be based on four principles:

- We must demand rigid adherence to Defense Department contract requirements, emphasizing this attitude during pre-contract activities and demonstrating we mean it during contract performance.
- Top Defense Department procurement managers must bring to the attention of top industry managers serious instances of contract non-compliance to clearly demonstrate our serious concern and to insist on corrective action.
- We must treat waivers and deviations as basic system inadequacies, reacting with vigorous demands for corrective actions. Waivers should be granted only when there is overriding benefit to the Defense Department. Cost considerations should demonstrate that contract compliance is the most cost-effective way for contractors to do business with the Defense Department. Above all, we must not become conditioned to the approval of waivers as a routine way of doing business.
- Meeting of delivery schedules and quality of delivered material must be viewed as a single entity. We must demand that only contractually compliant material be offered to the Defense Department.

The joint logistics commanders declared that the principles expressed here must be ingrained into the day-to-day attitudes of each individual in the procurement cycle.

In a letter to all Defense Supply Agency activities and Defense Contract Administration Services personnel, Lieutenant General Earl C. Hedlund, Director of the Defense Supply Agency, endorsed the joint logistics commanders' procurement attitude. He wrote:

"Enforcement of contract terms must include quality program and inspection system requirements as well as product compliance. Additionally, to prevent problems from developing, contractors who demonstrate an inability or an unwillingness to comply with all terms should not normally be recommended for or awarded additional contracts."

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